FINAL

Shallow Soils Investigation/Treatability Testing Results Report
Davis Global Communications Site

McClellan Air Force Base
California

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base, Texas

and

Environmental Management
McClellan Air Force Base
California

April 1999

PARSONS
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SHALLOW SOILS INVESTIGATION/TREATABILITY TESTING RESULTS REPORT

DAVIS GLOBAL COMMUNICATIONS SITE

McCLELLAN AFB
DAVIS, CALIFORNIA

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Prepared for:

Air Force Center for Environmental Excellence
Brooks AFB, Texas

and

Environmental Management
McClellan AFB, California

Prepared by:

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LIST OF ABBREVIATIONS AND ACRONYMS

µg/L	Micrograms per liter
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CAC	California Administrative Code
Cal/EPA	California Environmental Protection Agency
cfm	Cubic feet per minute
DI-WET	Deionized water waste extraction test
DLM	Designated Level Methodology
DOT	Department of Transportation
EAF	environmental attenuation factor
EMR	Environmental Management Office
ES	Engineering-Science, Inc.
ID	Inside diameter
IRP	Installation Restoration Program
mg/kg	Milligrams per kilogram
NFI	No further investigation
OD	Outside diameter
Parsons ES	Parsons Engineering Science, Inc.
PCE	Perchloroethene
PID	Photoionization detector
ppmv	parts per million, by volume
PRL	Potential Release Location
psi	Pounds per square inch
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
RWQCB	Regional Water Quality Control Board
SAI	Specialized Assays, Inc.
scfm	Standard cubic feet per minute
SM-ALC	Sacramento Air Logistics Center
SOP	Standard operating procedure
SVE	Soil vapor extraction
SWRCB	State Water Resources Control Board
TCE	Trichloroethene
TRPH	Total recoverable petroleum hydrocarbons
TPH	Total petroleum hydrocarbons
TPH-d	Total petroleum hydrocarbons as diesel
TPH-g	Total petroleum hydrocarbons as gasoline
TVH	Total volatile hydrocarbons

TVHA	Total volatile hydrocarbon analyzer
US	United States
USEPA	US Environmental Protection Agency
UFST	Underground fuel storage tank
VMP	Vapor monitoring point
VOC	Volatile organic compound
VW	Vent well
WQG	Water Quality Goal

SECTION 1

INTRODUCTION

1.1 PURPOSE

This results report for the Davis Global Communications Site (Davis Site), in Davis California, has been prepared by Parsons Engineering Science, Inc. (Parsons ES; formerly Engineering-Science, Inc. [ES]) for submittal to the California Regional Water Quality Control Board (RWQCB), Central Valley Region; the US Air Force Center for Environmental Excellence (AFCEE), Brooks AFB, Texas; and Sacramento Air Logistics Center, Environmental Management Office (SM-ALC/EMR), McClellan Air Force Base (AFB), California. This report has been prepared as part of the AFCEE Extended Bioventing Project (Contract F41624-92-8036, Delivery Order 17). The purpose of this report is to provide findings of the shallow soils investigation and treatability testing event performed in January/February 1999 and make recommendations based on these findings.

1.2 SITE AND PROJECT BACKGROUND

1.2.1 Site Description and Background

The Davis Site is located approximately 20 miles southwest of McClellan AFB in Davis, California and occupies approximately 316 acres in a predominantly agricultural area. The location of the Davis Site with respect to McClellan AFB is shown on Figure 1.1. The Davis Site serves as a communications annex for McClellan AFB and is manned 24 hours a day by communication squadron personnel assigned to McClellan AFB. Operational facilities and controls are located within a fenced compound located near the center of the Davis Site. Outside the fence area are more than two dozen antennae and transmitters.

In the southeast portion of the Main Compound Area is the former location of three 25,000-gallon underground fuel storage tanks (UFSTs) used to store diesel fuel for a generator housed in Building 4710 (Figure 1.2). In 1985, the UFSTs were found to be leaking and were replaced by an aboveground diesel fuel storage tank installed on the north side of Building 4710. In May 1988, the UFSTs were excavated and removed, but a concrete pad used to anchor the UFSTs was left in place at approximately 13 feet below ground surface (bgs). This concrete pad was subsequently removed in September 1998.

The subsurface lithology of the site in the vicinity of the former UFSTs and concrete pad consists of fill material, below which are laterally continuous intervals of clay, clayey/silty sand, sand, and gravels. During a 1993 investigation by ES (1994), a fill

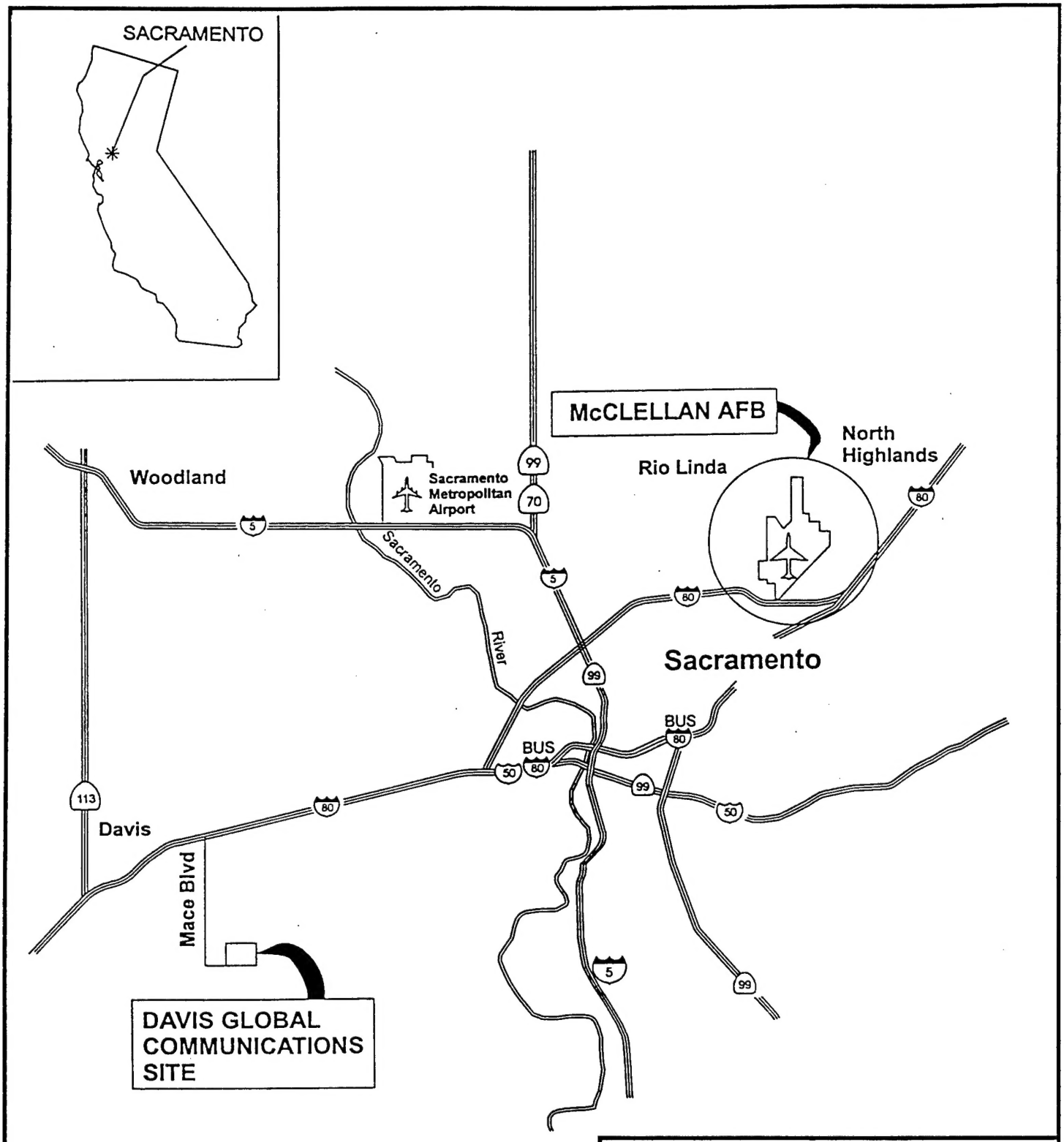

FIGURE 1.1

SITE LOCATION

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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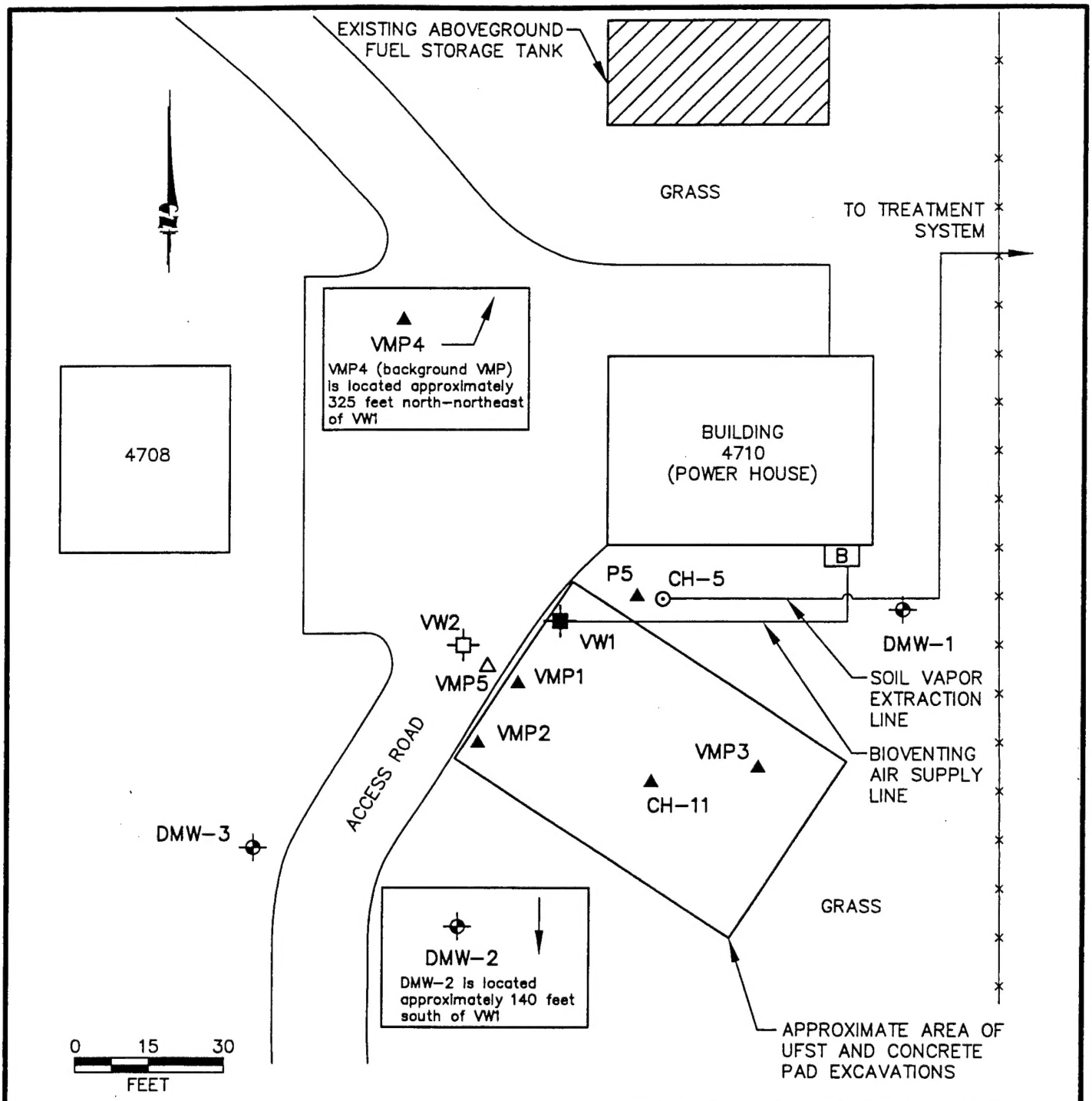

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FIGURE 1.2

SITE PLAN

Davis Global Communications Site
McClellan AFB, California

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Denver, Colorado

material consisting of brown, sandy/clayey silt with minor amounts of gravel was found in the uppermost unit to a depth of between 6 and 13 feet bgs. The native soil present below the UFST fill material was composed of a silty, lean clay to approximately 25 feet bgs. From approximately 25 to 30 feet bgs, predominantly clayey sands were encountered. Fine to medium-grained sand was encountered from approximately 30 to 35 feet bgs. Below the sand, an approximately 1 foot thick interval of basal gravel was identified. Below this gravel interval, predominantly clayey silts and silty clays were identified to at least a depth of 60 feet bgs. During this investigation, groundwater was encountered at approximately 55 feet bgs (ES, 1994); however, seasonal groundwater fluctuations at the Davis Site can be significant. During wet winter/spring months, the depth to the groundwater has measured as shallow as 6 feet bgs (Soper, 1998).

Environmental investigations at the Davis Site began in 1981 and the site is currently part of the United States (US) Air Force Installation Restoration Program (IRP). Petroleum hydrocarbon contamination has been detected in soil, soil vapor, and groundwater as a result of the former leaking UFSTs. Chlorinated volatile organic compounds (VOCs), including trichloroethene (TCE) and tetrachloroethene (or perchloroethene [PCE]) also have been detected in groundwater, but the source of the chlorinated VOCs is unrelated to the UFSTs.

1.2.2 Project Background

Since 1992, McClellan AFB has participated in two AFCEE-sponsored bioventing projects: currently the Extended Bioventing Project, and formerly the Bioventing Pilot Test Initiative. As part of the nationwide Bioventing Pilot Test Initiative, *in situ* bioventing pilot tests were conducted at approximately 145 sites at 56 Air Force installations, including the Davis Site and six other McClellan AFB sites (ES, 1994; Parsons ES, 1996) (Bioventing pilot testing at an eighth McClellan AFB site, Site ST200, has been performed under the Extended Bioventing Project [Parsons ES, 1998b]). These tests were designed to collect data on the effectiveness of bioventing for the remediation of soil contaminated with fuel hydrocarbons (e.g., JP-4 jet fuel, diesel fuel, gasoline, or heating oil). Based on the success of the Bioventing Pilot Test Initiative, the Extended Bioventing Project provided funding for pilot testing, system expansion, continued system operation, and for confirmation or closure soil sampling when system monitoring results indicated sufficient remediation of petroleum-contaminated soils. Four McClellan AFB sites (Potential Release Location [PRL] T-18, Study Area 6 (SA 6), ST200, and the Davis Global Communications Site in Davis, California) were included in the Extended Bioventing Project. One site, PRL T-18 (also known as Tank Farm #4) has already received no further investigation (NFI) status (Parsons ES, 1997; California RWQCB, 1997) and another site, SA 6, is currently pending.

1.2.2.1 Bioventing Pilot Test Activities

Beginning in July 1993, activities performed at the Davis Site as part of the Bioventing Pilot Test Initiative included the following (ES, 1994; AFCEE, 1995):

- Installation of one air injection vent well (VW1), three vapor monitoring points (VMP1, VMP2, and VMP3), and one background vapor monitoring point (VMP4) (Figure 1.2);
- Baseline soil and soil vapor sampling and *in situ* respiration testing;
- Installation of a 1.0-horsepower regenerative blower and blower system;
- Air permeability and oxygen influence testing; and
- Extended pilot-scale bioventing system operation followed by 1-year soil and soil vapor sampling and *in situ* respiration testing.

Soil and soil vapor results following 1 year of pilot scale bioventing indicated that total recoverable petroleum hydrocarbon (TRPH) concentrations in soil and total volatile hydrocarbon (TVH) concentrations in soil vapor had been reduced by approximately 1 order of magnitude at some locations (AFCEE, 1995). The data also indicated that although petroleum contamination remained in Davis Site soils, those contaminants that contribute most significantly to site risk, benzene, toluene, ethylbenzene, and xylenes (BTEX), were not significant in soil or soil vapor. McClellan AFB personnel continued to operate the pilot-scale bioventing system following the 1-year pilot test.

1.2.2.2 Extended Bioventing Activities

Based on the encouraging 1-year results, continued operation and monitoring of the Davis Site bioventing system was included under the Extended Bioventing Project. As part of this project, funding for 1 year of bioventing system maintenance with year-end respiration testing and soil vapor sampling (Option 1) was provided, as was funding for a confirmation soil sampling event (Option 2).

The 1-year of AFCEE-funded maintenance and monitoring of the bioventing system began in June 1996. At approximately this same time, soil vapor extraction (SVE) and groundwater extraction operations were initiated by another contractor at the Davis Site as part of the remediation efforts for the TCE contamination in groundwater. Two of the SVE system components, extraction well CH-5 and soil vapor monitoring point CH-11, were installed near the bioventing pilot test area (Figure 1.2). In June 1997, oxygen influence measurements were taken with air injection bioventing occurring at VW1 and air extraction occurring at CH-5. Option 1 testing was performed in July 1997 following a 1 month shut down of air injection/extraction activities to allow site soils to return to equilibrium conditions. The results of these testing events indicated that air injection at VW1 and/or air extraction at CH-5 appeared to be effectively aerating and enhancing bioremediation of petroleum hydrocarbon-contaminated soils greater than 25 feet bgs, including smear zone soils, and to a lesser extent more shallow soils at VMP2 (Parsons ES, 1998a). However, results also indicated that the 15-foot screened intervals at VMP1 and VMP2 (VMP1-15 and VMP2-15) were not being effectively aerated by air injection/extraction and that fuel hydrocarbons remained in the shallow, low permeability soils.

In September 1998, the concrete pad used to anchor the former UFSTs was removed under a separate McClellan AFB (1998) contract. During the excavation, petroleum-contaminated soils, above and beneath the pad, also were removed down to approximately 22 feet bgs and transported to the Davis Site soil stockpile. Figure 1.3 shows the sample locations and TPH and BTEX results for soil samples collected during excavation activities (additional VOC and SVOC analytical results are shown on Table 2.4 of Appendix A). Sample results for soils collected above the concrete pad at 10 feet bgs (982536-10' and 982537-10') demonstrated that residual petroleum contamination exceeding 1,000 milligrams per kilogram (mg/kg) was present in the shallow low permeability soils and these soils were not benefiting significantly from air injection at VW1. Excavation and removal of contaminated soils down to 22 feet bgs eliminated the most significant source of petroleum contamination remaining at the site. However, visual evidence of contamination observed in adjoining soils to the southwest and southeast of the main excavation indicated that some petroleum hydrocarbon contamination was potentially left in place in the shallow, low permeability soils. Minor excavations were made in these areas, but no soil samples were collected and the areal extent of contamination was not delineated.

Following removal of the petroleum-contaminated soils and concrete pad, it was presumed that continued air injection bioventing at VW1 and air extraction at CH-5 would have little impact on any remaining petroleum contamination in the shallow, low permeability soils southwest and southeast of the main excavation. Therefore, AFCEE and McClellan AFB requested that Option 2 funds originally intended solely for confirmation soil sampling also be used to investigate the remaining extent of shallow soil contamination in these areas and to perform a shallow soils bioventing treatability test.

This report presents the results of confirmation soil sampling and the shallow soils investigation and treatability testing performed at the Davis Site in January and February 1999. In preparation for the investigation and treatability testing event, a site-specific work plan was prepared by Parsons ES (1998c) and is provided as Appendix A of this report. Following McClellan AFB and California RWQCB approval of the work plan, confirmation and investigative soil sampling and bioventing system installation for the treatability test were conducted from 14 to 21 January 1999. Soil sampling activities consisted of advancing 9 borings to total depths between approximately 16 and 33 feet bgs, and analyzing selected soils samples for total petroleum hydrocarbons as diesel (TPH-d) (total and soluble), BTEX, and moisture content. A total of 18 soil samples from the 9 borings were submitted for laboratory analysis. One air injection VW (VW2) was installed for the shallow soils treatability test and a supplemental VMP (VMP5) also was installed. Locations for the soil borings, VW2, and VMP5 are provided in Section 2.

The shallow soils treatability test was performed between 9 and 18 February 1999. An air and helium mixture was injected into VW2 for approximately 9 days while changes in soil vapor oxygen and helium levels and changes in pressure response were monitored at VMP1, VMP2, and newly installed VMP5.

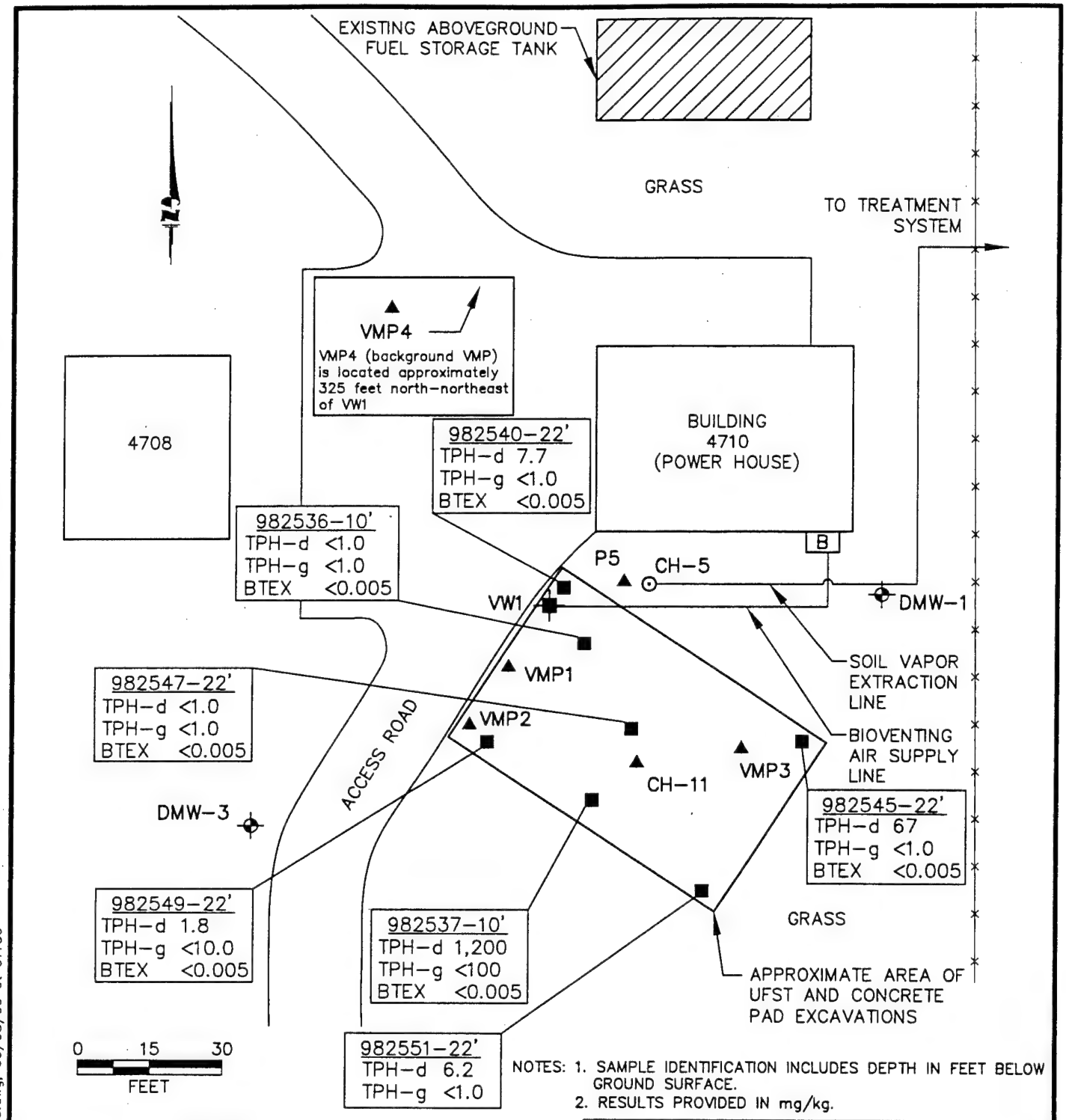

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FIGURE 1.3

1998 CONCRETE PAD EXCAVATION SOIL SAMPLING LOCATIONS AND RESULTS

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

1.3 SUMMARY OF SAMPLING AND TREATABILITY TESTING RESULTS

Soil sample analytical results indicate that the most significant petroleum hydrocarbon contamination remains in site soils beneath the former UFSTs. TPH-d was detected in 3 of the 18 soil samples collected at the site. The maximum total and soluble TPH-d concentrations, 264 mg/kg and 550 micrograms per liter (μg/L), respectively, were detected in the sample collected from 32.5 to 33 feet bgs in the boring advanced adjacent to VW1 (boring SB1). In addition, TPH-d was detected in the two samples collected between 15 and 16 feet bgs in the boring advanced adjacent to VMP1 (boring SB2). Soil analytical results indicate that while there was visual evidence of contamination observed southwest and southeast of the concrete pad removal area, the remaining contamination is relatively insignificant and not widespread. Little to no BTEX contamination was evident in site soils; the maximum BTEX concentration (0.0208 mg/kg) was detected in the sample collected from SB2 (adjacent to VMP1) between 15 and 15.5 feet bgs.

Results of the shallow soils bioventing treatability test indicate that the low permeability soils located between 5 and 25 feet bgs can be effectively aerated with air injection targeted specifically into this interval. Oxygen influence was observed to a distance of at least 20 feet from VW2. Treatability testing results also indicated that the most appropriate location for extended shallow soils bioventing is the original source area. Soil vapor concentrations in the shallow soils at VMP1 and VMP2 continue to exhibit signs of residual fuel contamination and ongoing aerobic fuel biodegradation even after the September 1998 removal of the concrete pad and petroleum contaminated soils to the southeast of these locations.

Based on these results, bioventing treatment of the shallow, low permeability soils in the original source area on the northwest side of the excavation is recommended by performing longer-term air injection in VW2. Further TPH-d reductions are recommended in these source area soils because the seasonal high water table conditions potentially bring site groundwater into direct contact with contaminated soils.

1.4 REPORT ORGANIZATION

This results report consists of five sections including this introduction and three appendices. Section 2 includes a description of the confirmation and investigative soil sampling, the treatability test design and construction, and the soil vapor sampling and oxygen influence testing activities conducted at the site. Section 3 summarizes the soil sampling analytical results and the treatability test results. Section 4 presents conclusions and recommendations; references used in preparation of this report are provided in Section 5.

Appendix A presents a copy of the work plan for the Davis Site, which includes a detailed summary of previous site investigations. Appendix B provides copies of soil boring logs from the soil sampling event. Appendix C presents laboratory analytical data for site environmental and quality assurance/quality control (QA/QC) samples, and chain-of-custody forms. Appendix D presents a data quality assessment report.

SECTION 2

SHALLOW SOILS INVESTIGATION AND TREATABILITY TESTING ACTIVITIES

This section summarizes the soil confirmation and investigation sampling activities performed at the Davis Site including sampling locations and depths, sampling procedures, analytical methods, and QA/QC procedures followed. In addition, this section provides information pertaining to the design, construction, and performance of the bioventing treatability test. The soil sampling and bioventing treatability testing activities are described in more detail in the work plan for the Davis Global Communications Site (see Appendix A). The work plan was implemented by qualified Parsons ES scientists and engineers trained in conducting soil sampling and bioventing pilot testing activities.

Drilling, soil sampling, and installation of VW2 and VMP5 were conducted between 14 and 21 January 1999. Drilling services were provided by PC Exploration of Rocklin, California. Drilling, soil sampling, and well installation were directed by Ms. Amanda Freeman Bielskis of the Parsons ES office in Oakland, California.

2.1 SOIL SAMPLING PROCEDURES

2.1.1 Boring Locations and Sampling Depths

Confirmation and investigation soil sampling was conducted at the site between 14 and 21 January 1999. Nine soil borings (SB1 through SB8, and SB11) were advanced at the site, and 18 soil samples (16 primary samples, and replicate samples at SB2 and SB11) were collected for laboratory analysis. The soil borings were located in the vicinity of the former UFSTs and concrete pad, south of Building 4710 (Figure 2.1). Two confirmation soil borings, SB1 and SB2, were advanced adjacent to VW1 and VMP1, respectively, for the purpose of comparing petroleum hydrocarbon concentrations in soil with initial and 1-year results from the Bioventing Test Initiative (Appendix A, Table 2.1). Soil borings SB3 and SB4 were advanced southwest of the UFST and concrete pad excavations, and soil borings SB5, SB6, and SB11 were advanced southeast of the excavations, to delineate the extent of contamination present in shallow soils. Soil borings SB7 and SB8 were advanced northwest of the excavations for soil sampling and installation of the treatability test VW (VW2) and supplemental VMP (VMP5), respectively.

Soil borings were advanced using a drill rig equipped with 8-inch outside-diameter (OD) hollow-stem augers. At SB1, one confirmation soil sample was collected between 32.5 and 33 feet bgs. The soil sample was saturated and the groundwater level

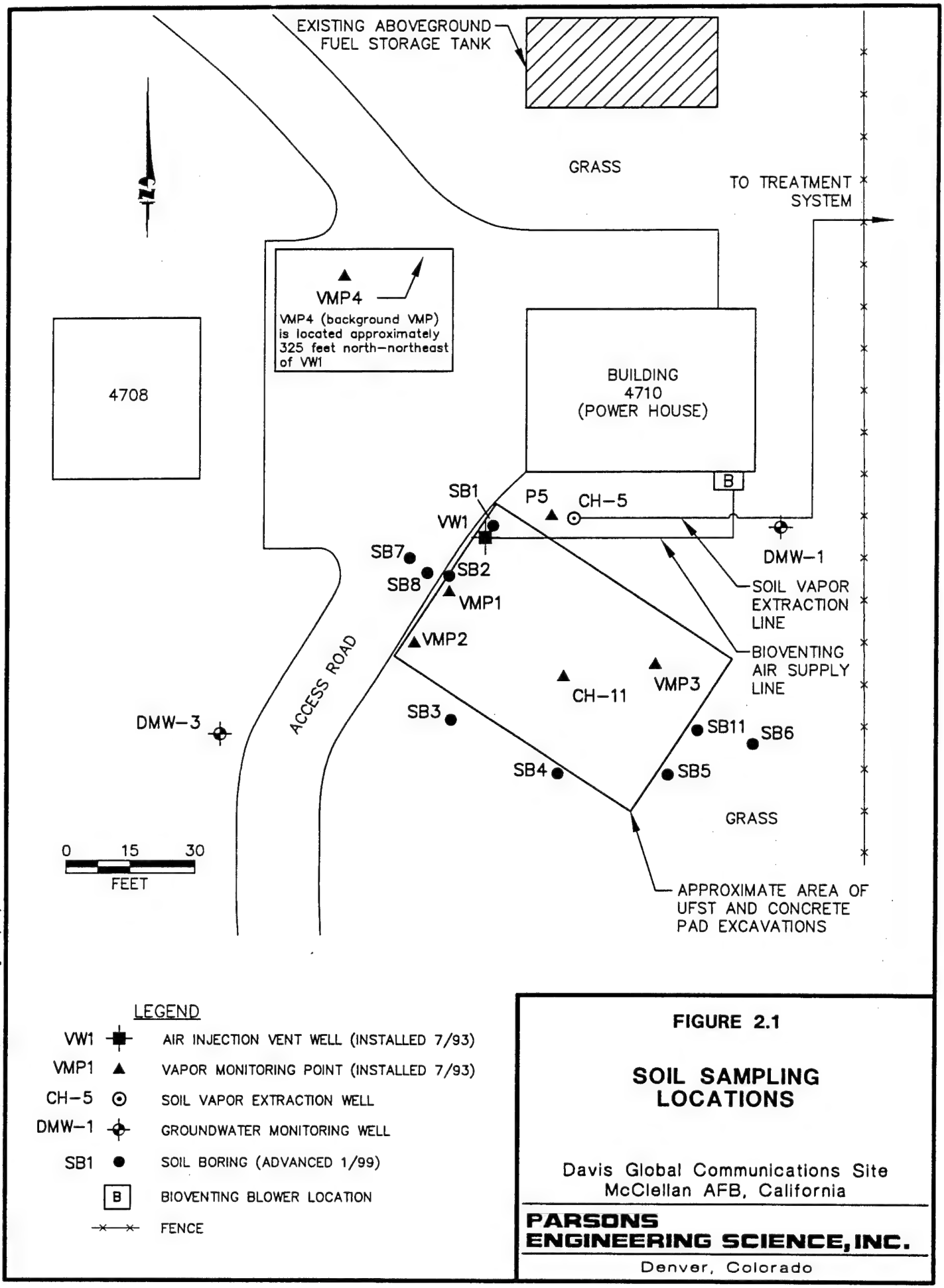

FIGURE 2.1

SOIL SAMPLING LOCATIONS

Davis Global Communications Site
McClellan AFB, California

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Denver, Colorado

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measured at VW1 was approximately 29 feet bgs. One confirmation sample and one replicate sample were collected at SB2 between 15 and 16 feet bgs. Investigative soil borings SB3, SB4, SB5, SB6, and SB11 were advanced to approximately 25 feet bgs.

A hand auger was used between 0 and approximately 5 feet bgs to initiate these borings. Further boring advancement was performed using the drill rig and hollow-stem augers and continuous coring was performed from 5 feet bgs to total depth in order to best select soil intervals for sampling. Two soil samples from each of these borings was submitted for laboratory analysis based on field observations (physical evidence of contamination and headspace measurements), and one replicate sample also was submitted from boring SB11. Soil borings SB7 and SB8 were advanced to approximately 27 feet bgs for installation of VW2 and VMP5, respectively. Continuous coring was performed in each of these borings from approximately 5 feet bgs to total depth and two soil samples from each of these borings were submitted for laboratory analysis. To provide complete documentation of the sampling event, detailed boring logs were generated by the Parsons ES field geologist. Boring logs from the confirmation/investigation soil sampling event are provided in Appendix B of this report.

2.1.2 Soil Sampling Procedures

Undisturbed soil samples, suitable for chemical analysis, were collected from soil borings using a standard split-barrel sampler fitted with three pre-cleaned, 6-inch long, thin-walled, brass sleeves. For each sampling interval, the soil sampler was lowered through the hollow stem of the augers and driven approximately 1.5 feet into undisturbed soil, ahead of the augers. After sample collection, the soil sampler was retrieved, split apart, and the brass sleeves were removed. A portion of soil from each split spoon was examined for physical evidence of hydrocarbon contamination (e.g., odors and staining) and evaluated by soil headspace measurements using a total volatile hydrocarbon analyzer (TVHA) and a photoionization detector (PID). Soil types were described in accordance with the standard Parsons ES soil description format and the Unified Soil Classification System. At each sampling interval, the brass sleeves that were not used for field evaluation were immediately capped with Teflon® tape and plastic endcaps in preparation for possible laboratory submittal.

A total of 18 soil samples, including 2 replicate samples, were submitted for laboratory analysis. Soil samples selected for laboratory analysis were labeled with the site name and soil boring number, sample depth, and date of collection. Sample containers were placed in an insulated shipping container packed with ice. Samples for laboratory analysis were shipped under standard chain-of-custody procedures to Specialized Assays Inc. (SAI) of Nashville, Tennessee.

2.1.3 Equipment Decontamination and Site Restoration

All sampling and downhole equipment were decontaminated in accordance with McClellan AFB standard operating procedures (SOP)s for drilling and soil sampling operations, except that isopropanol was used in place of methanol as a final decontamination step for the soil samplers and sampling tools. All decontamination fluids and drill cuttings were containerized on site in labeled US Department of

Transportation (DOT)-approved 55-gallon drums provided by the base soil disposal contractor. The base disposal contractor transported containerized wastes to the appropriate facility at McClellan AFB.

Soil borings that were not converted to wells were abandoned with a bentonite/cement grout mixture. Soil borings SB7 and SB8 were completed as VW2 and VMP5, respectively, and were completed at the surface using asphalt patch to match the existing pavement.

2.1.4 Soil Analyses

All soil samples were analyzed by SAI, a State of California-certified laboratory. Soil samples were analyzed by USEPA Method SW8015-modified for TPH-d, by USEPA Method SW8021B for BTEX, and by American Society for Testing and Materials (ASTM) D-2216 for soil moisture. Soil samples determined by the laboratory to contain total TPH-d also were analyzed for soluble TPH-d using the waste extraction test preparation method described in California Administrative Code (CAC) Title 22, Article 11, Section 66700 (C through F) except that the extraction solution for the test was deionized water (DI-WET).

2.2 TREATABILITY TEST DESIGN AND CONSTRUCTION

Figure 2.2 is a site layout showing the location of VW2 and VMP5 with respect to existing VMP1 and VMP2. Geologic boring logs and well completion diagrams are provided in Appendix B.

2.2.1 Vent Well Installation

VW2 was installed on the northwest side of the excavation area, approximately 12 feet from VMP1 and 20 feet from VMP2. This location was chosen in order to utilize the shallow screened intervals at VMP1 (VMP1-15 and VMP1-25) and VMP2 (VMP2-15) for the shallow soils treatability test. In addition, the results of the July 1997 Option 1 testing event indicated that petroleum hydrocarbon contamination remained in shallow soils at VMP1 and VMP2 and was not being effectively treated by air injection at VW1 (Parsons ES, 1998a). Although the petroleum-contaminated soils southeast of VMP1 and VMP2 were removed during excavation of the concrete pad in September 1998, successful oxygenation of the shallow low permeability soils in this area would help support aerobic biodegradation of any remaining shallow contamination that on the northwest side of the excavation.

In preparation for VW construction, a 10-inch scraping blade was attached to the end of the augers and advanced to total depth to minimize the potential for borehole smearing with wet clay. VW2 was constructed using 4-inch inside diameter (ID), Schedule 40 polyvinyl chloride (PVC) casing and 0.04-inch slotted PVC screen. The total depth of VW2 is 27.5 feet bgs. The screened interval for VW2 was set between 5 and 25 feet bgs. The annular space between the well casing and the borehole was filled with #3 silica sand from the bottom of the screened interval to 1 foot above the top of the interval. Bentonite was placed above the sand, hydrated in place, and overlaid with a cement/bentonite grout seal. Flexible PVC air supply piping was used to connect

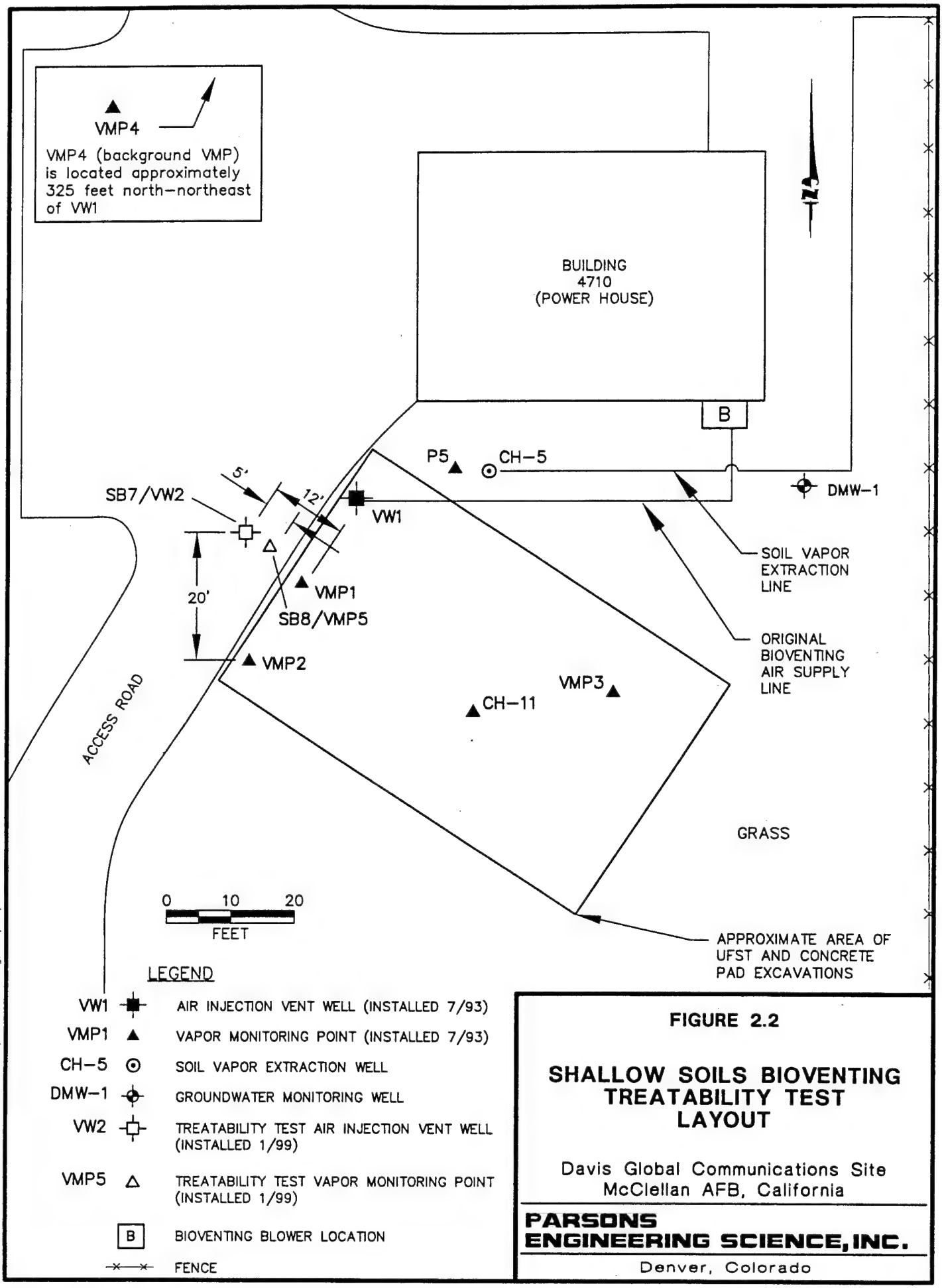

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FIGURE 2.2

SHALLOW SOILS BIOVENTING TREATABILITY TEST LAYOUT

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

VW2 to the treatability test blower. VW2 was completed with a heavy-duty, 18-inch diameter, water-tight, traffic-proof, cast-iron well box (securable with hexbolts) emplaced within a concrete collar. Construction details for VW2 are presented on Figure 2.3.

2.2.2 Soil Vapor Monitoring Point Installation

Prior to VMP installation, an 8-inch scraping blade was used to remove smeared clay from the borehole walls. VMP5 was constructed as a multi-depth VMP as shown on Figure 2.4. The VMP screens were installed at 7.5, 15, and 22 feet bgs. VMP5 was installed approximately 5 feet from VW2 and provides the closest monitoring location for pressure and oxygen influence during air injection into VW2. As shown on Figure 2.4, each individual VMP interval was constructed using 6-inch sections of 1-inch-diameter PVC well screen with 0.5-inch ID PVC riser pipes extending to the ground surface. Filter pack intervals consisting of #3 sieve size silica sand were placed in the annular space adjacent to each VMP screen and a bentonite seal was emplaced on top of the filter packs. The upper 1 foot of VMP casing was completed with a ball valve and a hose barb to allow soil gas sample collection and pressure measurements. The surface completion consisted of heavy-duty, 18-inch diameter, water-tight, traffic-proof, cast-iron well box (securable with hexbolts) emplaced within a concrete collar. It is worth noting that soil vapor samples were substantially easier to collect from VMP5, compared to VMP1 and VMP2, suggesting the scraping blade was effective in minimizing borehole smearing.

2.2.3 Blower Unit

A portable, 3.0-horsepower, positive displacement blower was used at the Davis Site for the bioventing treatability test. The blower was energized by 230-volt, single-phase, 30-amp power from the existing power line located on the southeast side of Building 4710, next to the existing pilot-scale blower and blower shed (Figure 2.2). The treatability test blower was configured to inject air at approximately 1 standard cubic feet per minute (scfm) with a pressure at the VW2 wellhead of 2 pounds per square inch (psi). The basic configuration and instrumentation for the treatability test blower system are shown in Appendix A, Figure 3.5.

2.3 TREATABILITY TEST PROCEDURES

To allow the subsurface to return to equilibrium conditions prior to the treatability test, the bioventing system was shut down on 21 December 1998. The extraction of soil vapors from well CH-5 was discontinued prior to 21 December 1998.

For the shallow soils bioventing treatability test, baseline soil vapor sampling and an extended radius of influence test was performed. Initial soil vapor sampling was performed on 9 February 1999. The radius of influence test was initiated on 9 February 1999 and completed on 18 February 1999.

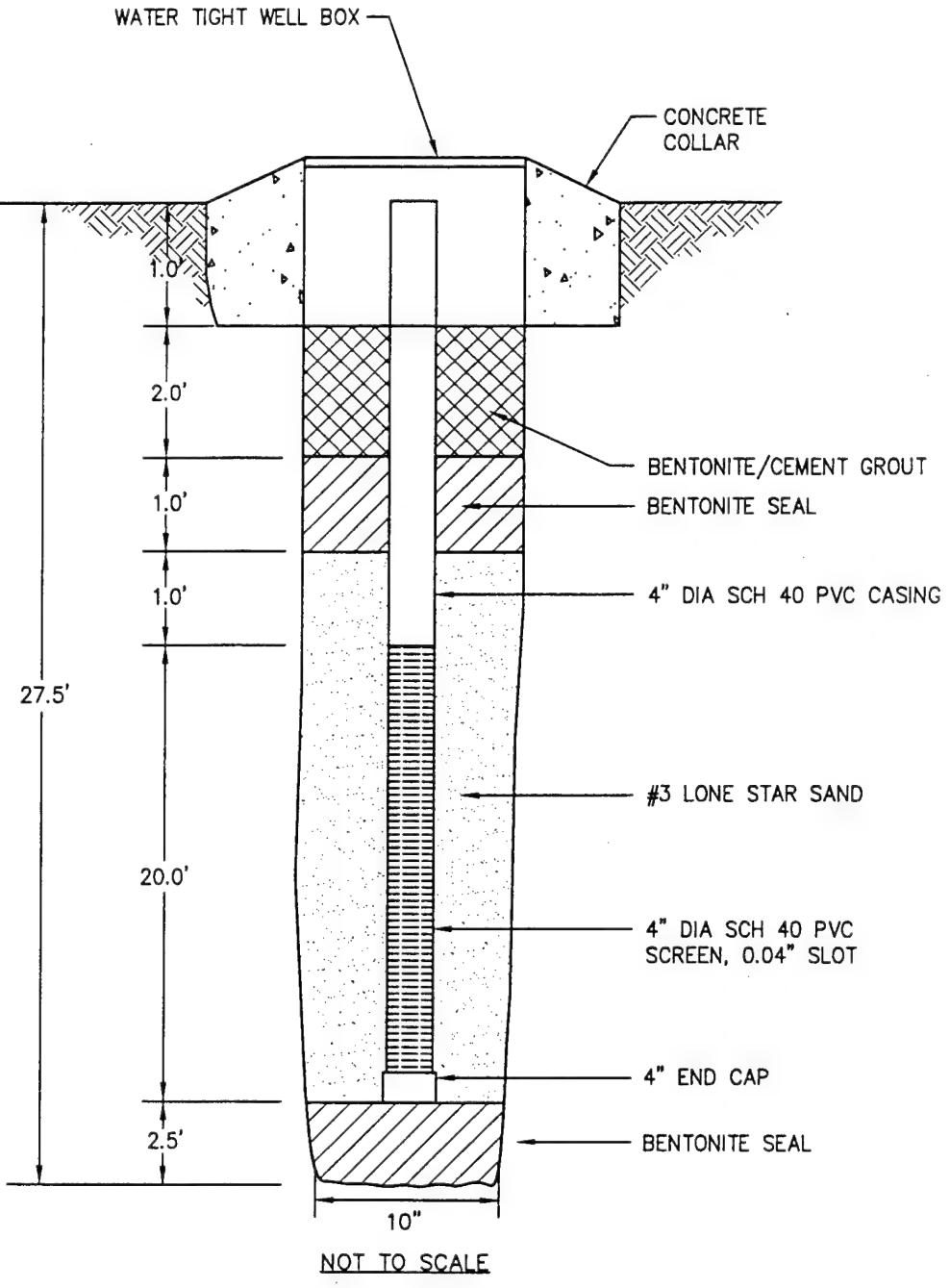


FIGURE 2.3

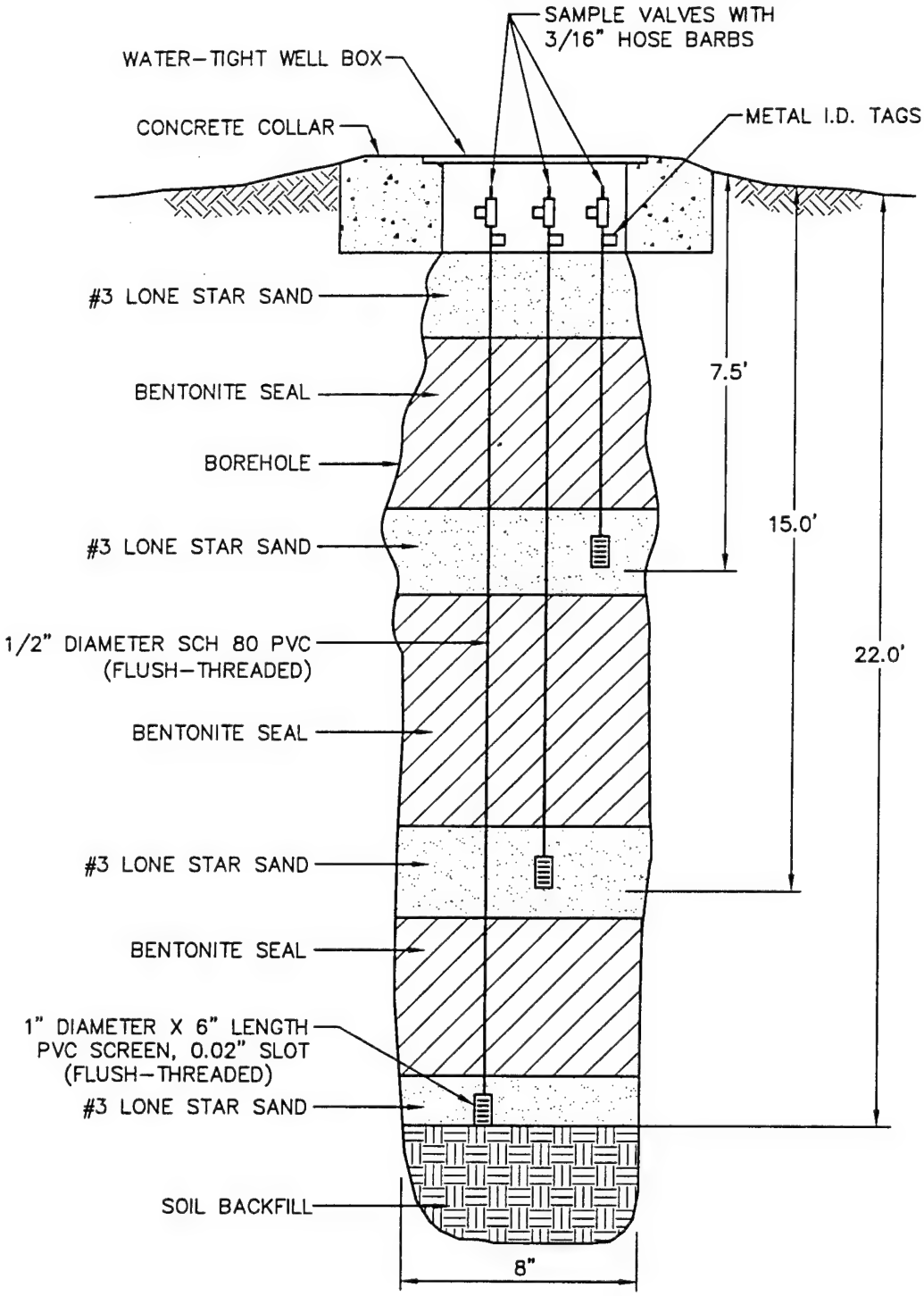
AS-BUILT INJECTION VENT WELL CONSTRUCTION DETAIL VW2

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

S:\ES\cad\AFCEE\726876\McClellan\99dn0166.dwg, 03/08/99 at 07:58



NOT TO SCALE

FIGURE 2.4

AS-BUILT VAPOR MONITORING POINT CONSTRUCTION DETAIL VMP5

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

S:\ES\cad\AFCEE\726876\McClellan\99dn0167.dwg, 02/19/99 at 13:19

2.3.1 Soil Vapor Sampling

After VW2 and VMP5 construction and prior to startup of the treatability test blower, subsurface soil vapor samples were collected from VW2, VMP1, VMP2, and VMP5 for field analysis according to procedures outlined in the bioventing protocol (Hinchee et al., 1992) and protocol addendum (Downey and Hall, 1994). Soil vapor samples were field screened for oxygen, carbon dioxide, TVH, and ionizable compounds to determine initial, or baseline, soil vapor chemistry, prior to oxygen influence testing. Results are provided in Section 3. The baseline soil vapor samples collected from these locations represent the first soil vapor samples collected since the September 1998 removal of the subsurface concrete pad and petroleum contaminated soils above and below the pad.

2.3.2 Radius of Influence Testing

Treatability test air injection at VW2 was conducted for 9 days in order to determine the oxygen radius of influence in the shallow, low permeability soils. During air injection, helium was injected as a tracer gas at a low concentration of 2 to 5 percent by volume. Pressure influence and oxygen influence were evaluated during extended air injection at VW2. In addition, measurements of the helium tracer gas also were performed in order to infer movement of the injected air.

SECTION 3

SOIL SAMPLING AND BIOVENTING TREATABILITY TEST RESULTS

This section summarizes the analytical results from the confirmation and investigation soil sampling activities and provides the results of the shallow soils bioventing treatability test. Soil analytical results are compared to LUFT (California SWRCB, 1989) and DLM (RWQCB, 1989) guidelines in order to assess the potential threat of remaining residual petroleum hydrocarbon contamination to site groundwater. Soil vapor sampling and oxygen influence testing results are presented as well as a discussion on the effectiveness of shallow soils bioventing in relation to the extent of fuel contamination remaining in site soils. Soil analytical results are presented in Appendix C of this report.

3.1 SOIL ANALYTICAL RESULTS

Soil sample analytical results are summarized in Table 3.1. Total TPH-d was only detected above laboratory reporting limits in the confirmation samples collected in the vicinity of VW1 and VMP1. In the confirmation sample collected from SB1 at 32.5 to 33 feet bgs, total TPH-d was detected at a maximum concentration of 264 mg/kg. At SB2, total TPH-d was detected at 39.9 mg/kg in the primary soil sample and at 64.6 mg/kg in the replicate sample, each collected between 15 and 16 feet bgs. TPH-d was not detected above an estimated concentration of 6.41 mg/kg in any of the soil borings installed southwest (SB3 and SB4), southeast (SB5, SB6, and SB11), or northwest (SB7 and SB8) of the UFST and concrete pad excavations area (Figure 2.1).

For those soil samples containing total TPH-d above the laboratory reporting limits, soluble TPH-d analysis was performed in accordance with California DI-WET procedures. Other than the soluble TPH-d result for the soil sample collected 32.5 feet bgs at SB1 (550 μg/L), the residual petroleum hydrocarbon contamination remaining in site soils appears to be relatively insoluble. Soluble TPH-d concentrations in the two soil samples collected 15 to 16 feet bgs at SB2 were measured at nondetect or near nondetect levels.

As with previous soil sampling results (Appendix A, Table 2.1), little to no BTEX were observed in site soils. At SB2, toluene and total xylenes were detected at maximum concentrations of 0.0049 mg/kg and 0.0159 mg/kg, respectively, in the soil sample collected at 15 feet bgs. Total xylenes also were detected at 0.0048 mg/kg in the replicate sample collected 15.5 feet bgs at SB2. Benzene was detected at two locations, SB7 at 24 feet bgs and SB8 at 13 feet bgs, at 0.0012 mg/kg and an estimated concentration of 0.0017 mg/kg, respectively.

TABLE 3.1
JANUARY 1999 SOIL ANALYTICAL RESULTS FOR TPH AND BTEX
DAVIS GLOBAL COMMUNICATIONS SITE
McCLELLAN AFB, CALIFORNIA

Soil Boring	SBD[a] (feet bgs)[c]	SED[b] (feet bgs)	Total TPH SW8015-modified TPH-d (mg/kg)[d]	California DI-WET Soluble TPH-d (μg/L)[e]	SW8021B Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Total Xylenes (mg/kg)
SB1	32.5	33	264	550	< 0.0012[f]	< 0.0024	< 0.0024	< 0.0024
SB2	15	15.5	39.9	< 130	< 0.0012	0.0049	< 0.0024	0.0159
SB2[g]	15.5	16	64.6	130	< 0.0012	< 0.0024	< 0.0024	0.0048
SB3	9	9.5	1.60 J[h]	---[i]	< 0.0012	< 0.0025	< 0.0025	< 0.0025
SB3	22.5	23	1.36 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB4	13.5	14	1.90 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB4	21	21.5	1.33 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB5	13.5	14	1.78 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB5	21	21.5	1.98 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB6	12.5	13	1.78 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB6	23	23.5	1.81 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB7	18	18.5	2.49 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB7	24	24.5	6.41 J	---	0.0012	< 0.0024	< 0.0024	< 0.0024
SB8	13	13.5	1.37 J	---	0.0017 J	< 0.0024	< 0.0024	< 0.0024
SB8	24	24.5	1.69 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB11	12	12.5	1.98 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB11[j]	11.5	12	1.69 J	---	< 0.0012	< 0.0024	< 0.0024	< 0.0024
SB11	21	21.5	1.40 J	---	< 0.0012	< 0.0023	< 0.0023	< 0.0023

[a] SBD = sample beginning depth.

[b] SED = sample ending depth.

[c] feet bgs = feet below ground surface.

[d] mg/kg = milligrams per kilogram.

[e] μg/L = micrograms per liter.

[f] < and gray shading = analyte not detected above the sample quantitation limit shown.

[g] Sample at this interval identified as SB9A in the boring logs (Appendix B) and analytical data package (Appendix C).

[h] J = laboratory estimated value. The analyte was positively identified at a concentration between the sample quantitation limit and the reporting limit.

[i] --- = not analyzed.

[j] Sample at this interval identified as SB12A in the boring logs (Appendix B) and analytical data package (Appendix C).

3.1.1 Comparison to Bioventing Initiative Results

Samples from SB1 and SB2 were collected to confirm reductions in petroleum hydrocarbon concentrations in soils near VW1 and VMP1, respectively, after more than 5 years of pilot-scale bioventing system operation. Initial (July 1993) and 1-year (September 1994) soil sample results are presented in Appendix A, Table 2.1. While the January 1999 TPH-d results (obtained by USEPA Method SW8015-modified) can not be directly compared to the Bioventing Initiative TRPH results (obtained by USEPA Method 418.1), the confirmation soil sample results suggest that TPH concentrations in the vicinity of VW1 and VMP1 have been reduced by 1 to 2 orders of magnitude since the initiation of pilot-scale bioventing. At VW1, soil samples collected 32 feet bgs in 1993 and 1994 had TRPH concentrations of 15,500 and 3,150 mg/kg, respectively. In January 1999, total TPH-d was detected at SB1 in soils from this same depth interval at 264 mg/kg. Similarly, soil samples collected 15 feet bgs at VMP1 had initial and 1-year TRPH concentrations of 1,370 mg/kg and 330 mg/kg, respectively, and the average total TPH-d concentration detected at this location (SB2) in January 1999 was 52.3 mg/kg.

3.1.2 Comparison to Regulatory Guidelines

No specific cleanup standards exist for petroleum hydrocarbon-contaminated soils at McClellan AFB. Therefore, residual petroleum hydrocarbon concentrations remaining in site soils were further evaluated in accordance with California LUFT (California SWRCB, 1989) and DLM (California RWQCB, 1989) guidelines.

3.1.2.1 Comparison to LUFT Guidelines

The LUFT guidelines (California SWRCB, 1989) provide information pertaining to assessment, cleanup, and closure of sites where petroleum fuels have leaked from USTs and contaminated subsurface soils and/or groundwater. Because residual petroleum-hydrocarbon contaminated soils remaining at the Davis Site are most prevalent at depths greater than 15 feet bgs, contaminant leaching from soil to groundwater represents the most significant potential exposure pathway.

Table 2-1 of the LUFT guidelines (California SWRCB, 1989) presents a simplified methodology to assess the possible threat to groundwater from petroleum contaminated soils and provides maximum allowable BTEX and TPH soil concentrations that can be left in place without threatening groundwater. These allowable levels of soil contamination are provided based on consideration of various site features (e.g., depth to groundwater, fractures in the subsurface, average annual precipitation) used to estimate whether a low, medium, or high leaching potential exists at a site. The maximum allowable BTEX and TPH concentrations that can be left in place based on these leaching potential categories are shown in Table 3.2 along with the maximum detected BTEX and TPH soil results from the January 1999 soil sampling event.

Comparing maximum detected confirmation soil sample results to the maximum allowable BTEX and TPH levels shown in Table 3.2 indicates that site soils pose a threat to groundwater if an evaluation of site features shows that a "high leaching potential" exists. Under this scenario, the maximum detected concentration of TPH-d

TABLE 3.2
COMPARISON OF TPH AND BTEX IN SOIL TO CALIFORNIA LUFT LEACHING CRITERIA
DAVIS GLOBAL COMMUNICATIONS SITE
McCLELLAN AFB, CALIFORNIA

Leaching Potential Category	TPH-d (mg/kg)[a/]	TPH-g (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)
Maximum Allowable Soil Concentrations [b/]						
Low	10,000	1,000	1.0	50	50	50
Medium	1,000	100	0.3	0.3	1.0	1.0
High	100	10	ND[c/]	ND	ND	ND
Maximum Detected Site Soil Concentrations						
	264	---[d/]	0.0017 J[e/]	0.0049	< 0.0025[f/]	0.0159

[a/] mg/kg = milligrams per kilogram.

[b/] Maximum allowable analyte concentration that can be left in place without threatening groundwater (California SWRCB, 1989).

[c/] ND = no detectable levels of BTEX are allowed (California SWRCB, 1989).

[d/] --- = not analyzed.

[e/] J = laboratory estimated value. The analyte was positively identified at a concentration between the sample quantitation limit and reporting limit.

[f/] < and gray shading = analyte not detected above the sample quantitation limit shown.

(264 mg/kg) exceeds the maximum allowable TPH-d soil concentration (100 mg/kg). An evaluation of site features and sample results against the criteria in Table 2-1 of the LUFT guidelines (California SWRCB, 1989) suggests that a "high leaching potential" exists at the Davis Site primarily because of the large seasonal water table fluctuations. During wet winter/spring months, the depth to groundwater has measured as little as 6 feet bgs (Soper, 1998) putting site groundwater in direct contact with those soils which are most contaminated.

3.1.2.2 Comparison to DLM Guidelines

The DLM guidelines (California RWQCB, 1989) provide a means to evaluate the soluble concentration of a contaminant against a designated level (DL) expected to be protective of the beneficial use(s) of groundwater considering environmental fate of the contaminant. Because essentially no BTEX was detected in Davis Site soils, the DLM was used to evaluate whether soluble TPH-d concentrations remaining in site soils present a significant threat to site groundwater.

A Soluble DL for TPH-d can be established using the following equation (California RWQCB, 1989):

Soluble DL = WQG x EAF x DF

Where:

WQG	=	Water Quality Goal for TPH-d
EAF	=	Environmental Attenuation Factor
DF	=	Dilution Factor (1/10 for the DI-WET Method)

In accordance with the DLM (California RWQCB, 1989), the WQG for a contaminant should be selected to protect the maximum number of beneficial uses, and as a result, the most restrictive (i.e., lowest) applicable and justifiable water quality criterion is recommended. For the protection of groundwater, the California Environmental Protection Agency (Cal/EPA, 1998) has identified a WQG of 100 μg/L for diesel oil based on taste and odor.

The EAF is used to approximate the degree of contaminant reduction that will occur as a result of natural environmental fate processes including adsorption, volatilization, dilution, dispersion, and chemical or biochemical degradation. The amount of environmental attenuation occurring at a site varies with site-specific hydrogeologic and pollutant characteristics including, but not limited to, depth to groundwater, net recharge, vadose zone permeability and clay content, total pollutant loading and pollutant sorption, solubility, and biodegradability. The greater the degree of expected attenuation from these processes, the larger the EAF used.

According to the DLM, a "generic" EAF of 100 should be used for deriving DLs in those situations which provide an "average" degree of natural protection for water quality from the discharge of wastes under reasonable worst-case conditions. For sites that provide less than this "average" level of protection, because of high groundwater or predominance of more highly permeable geologic materials, the DLM states that a lower EAF, such as 1 or 10 should be chosen. Based on the fact that site groundwater comes into direct contact with petroleum contaminated soils at the Davis Site, a more

conservative EAF such as 1 or 10 appears appropriate for estimating the DL for soluble TPH-d.

Using the soluble DL equation, a WQG of 100 μg/L for diesel oil, and an EAF of 10, a soluble DL for TPH-d contamination can be determined:

$$\text{TPH-d soluble DL} = 100\ \mu\text{g/L} \times 10 \times 1/10$$

$$= 100\ \mu\text{g/L}$$

Under these assumptions, soils analyzed using the DI-WET method will meet the soluble DL for petroleum hydrocarbons as diesel if their soluble TPH-d concentration is equal to, or less than, 100 μg/L. As shown in Table 3.1, soluble TPH-d results exceed this soluble DL in two of the three samples and the sample quantitation limit for the third sample (130 μg/L) also exceeds this soluble DL. Based on these results and the premise that an EAF of 10 may overestimate the degree of attenuation actually occurring between petroleum contaminated soils and groundwater, further remediation of site soils is recommended.

3.2 BIOVENTING TREATABILITY TEST RESULTS

3.2.1 Initial Soil Vapor Chemistry

The initial soil vapor concentrations at VW2 and the VMP screened intervals utilized during shallow soils treatability testing are shown in Table 3.3. The baseline soil vapor samples collected from these locations represent the first soil vapor samples collected since the September 1998 removal of the subsurface concrete pad and petroleum contaminated soils above and below the pad. High static oxygen and low TVH and PID measurements at VW2 indicate that soils at this location are not significantly contaminated with petroleum hydrocarbons. Some oxygen depletion (as compared to a 20.9 percent atmospheric oxygen concentration) and elevated hydrocarbon concentrations are indicated at VMP5, especially at the more shallow screened intervals. Nonetheless, static oxygen concentrations near 10 percent at these intervals indicate that soils are benefiting from natural oxygen diffusion from the surface and nearby uncontaminated soils.

Soil vapor concentrations in the shallow soils at VMP1 and VMP2 continue to exhibit signs of residual fuel contamination and ongoing aerobic fuel biodegradation even after the September 1998 removal of the concrete pad and petroleum contaminated soils to the southeast of these locations. Because petroleum contaminated soils deeper than 22 feet bgs were not removed, soils in the vicinity of VMP1-25 continue to exhibit static oxygen concentrations less than 1 percent and TVH levels near 100 parts per million, volume per volume (ppmv). Soil vapor samples from the remaining screened intervals of the VMPs could not be collected due to shallow groundwater conditions (approximately 25 feet bgs) during testing.

TABLE 3.3
INITIAL SOIL VAPOR CHEMISTRY
DAVIS GLOBAL COMMUNICATIONS SITE
McCLELLAN AFB, CALIFORNIA

Sample Location	Screen Depth (feet bgs)[a/]	Field Screening Data: Oxygen (percent)	Carbon Dioxide (percent)	TVH[b/] (ppmv)[c/]	PID[d/] (ppmv)
VW2	5-25	18.8	0.6	15	2.2
VMP1	15	8.5	7.0	NR[e/]	NR
VMP1	25	0.9	4.2	85	4.6
VMP2	15	6.0	5.2	110	4.8
VMP5	7.5	10.5	0.8	100	81.2
VMP5	15	10.1	0.8	45	8.0
VMP5	22	16.0	0.8	30	2.5

[a/] bgs = below ground surface.

[b/] TVH = total volatile hydrocarbons.

[c/] ppmv = parts per million, volume per volume.

[d/] PID = photoionization detector measurement of ionizable compounds.

[e/] NR = no reading (sample volume was inadequate).

3.2.2 VW2 Radius of Influence

Table 3.4 presents the change in oxygen and helium soil vapor concentrations and also shows static pressure measurements at the VMPs as a result of 9 days of shallow soils air injection at VW2.

During the period of air injection, helium was observed in soil vapor at all VMPs, and increases in soil vapor oxygen levels were observed at all VMPs except VMP1-15 and VMP5-15 (the presence of perched water and very tight soils at VMP1-15 hindered accurate soil vapor measurements at this location). At VMP2-15, soil vapor oxygen levels increased from 6 to 14 percent and helium was observed at 2.9 percent following 9 days of air injection. This result indicates successful oxygen transport to a radial distance of at least 20 feet (the distance from VW2 to VMP2). Significant oxygen increases also were evident at VMP1-25 (0.9 to 12 percent) and VMP5-7.5 (10.5 to 15.9 percent).

Pressure influence measurements suggest that advective air transport in the low permeability soils was low during the 9 days of air injection at VW2. While pressure influence was evident at all VMP screened intervals except VMP1-15 and VMP1-25, static pressures at the VMPs did not exceed 1 inch of water even with VW2 injection pressures of approximately 2 psi or 55 inches of water (VMP1-25 exhibited high vacuum throughout the test as a result of initial purging and very slow recovery due to tight soil conditions; VMP1-25 is screened slightly below the VW2 screened interval and slightly below the upper silt/clay layer). Advective air transport is expected to increase with longer-term shallow soils air injection since less permeable soils become more air conductive with long-term air injection. Although advective air transport was low, it resulted in significant increases in oxygen and helium concentrations with distance.

TABLE 3.4
INFLUENCE OF AIR INJECTION AT VW2 ON OXYGEN, HELIUM, AND PRESSURE RESPONSE
DAVIS GLOBAL COMMUNICATIONS SITE
McCLELLAN AFB, CALIFORNIA

TEST PARAMETERS:
Injection Well: VW2
Injection Pressure: 2.0 psi (or 55 inches of water)
Injection Flow Rate: 1.2 cubic feet per minute
Helium Concentration in Injected Air: between 2.5 and 5.0 percent.[a/]

Location	Screen Depth (feet bgs)[b/]	Distance From VW2 (feet)	Elapsed Time To Maximum Pressure (hours)	Maximum Pressure Response (inches of water)	Initial[c/] Oxygen (percent)	Initial[c/] Helium (percent)	Final[d/] Oxygen (percent)	Final[d/] Helium (percent)
VMP5	7.5	5	0.25	0.18	10.5	0.0	15.9	4.3
VMP5	15	5	45.5	0.10	10.1	0.0	6.0	1.5
VMP5	22	5	212	0.16	16.0	0.0	16.5	3.2
VMP1	15	12	NA[e/]	(>20)[f/]	8.5	0.0	NR[g/]	0.19
VMP1	25	12	NA	0.0	0.9	0.0	12.0	4.7
VMP2	15	20	166	0.36	6.0	0.0	14.0	2.9

[a/] A helium concentration of 5 percent was targeted, but at some times (e.g., overnight) the helium concentrations decreased and then required readjustment.
[b/] bgs = below ground surface.
[c/] Initial soil vapor measurements taken on 2/9/99.
[d/] Final soil vapor measurements taken on 2/18/99.
[e/] NA = not applicable; no pressure response measured at this location.
[f/] No pressure response; greater than 20 inches of water vacuum measured at this location throughout the air injection period.
[g/] NR = no reading; tight soils prevented collection of adequate sample volume.

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Soil sample analytical results indicate that the most significant petroleum hydrocarbon contamination at the Davis Site remains in site soils approximately 32 feet bgs near VW1 and 15 feet bgs near VMP1. Visual evidence of contamination observed in September 1998 to the southwest and southeast of the concrete pad and UFST excavations area does not appear to be widespread and appears to be relatively insignificant based on the January 1999 soil sample analytical results. Total TPH-d concentrations did not exceed reporting limits and BTEX was not detected in any of the eleven soil samples collected in these areas. In addition, little to no BTEX and TPH-d contamination was evident in four soil samples collected northwest of the excavation area. While total and soluble TPH-d concentrations exceeding LUFT and DLM guidelines for groundwater protection are still present in soils near VW1 and VMP1, petroleum hydrocarbon contaminant levels appear to have been reduced by 1 to 2 orders of magnitude as a result of more than 5 years of air injection/extraction activities at the site.

The presence of low permeability soils between 5 and 25 feet bgs and between 36 and at least 60 feet bgs (Appendix A, Figure 2.3 and Appendix B) have limited the effectiveness of air injection bioventing at VW1. Although VW1 is screened from 10 to 55 feet bgs, the "effective screened interval" caused by the low permeability silts and clays is much less than 45 feet, and is probably similar to the CH-5 screened interval (28 to 38 feet bgs). However, continued air injection at VW1 will sufficiently oxygenate site soils in this more permeable soil zone.

Results of the bioventing treatability test indicate that petroleum-contaminated, oxygen-depleted source area soils will also benefit from air injection bioventing within the shallow soil zone. Oxygen depleted soils were most notable near VMP1-25 (0.9 percent); however, static oxygen concentrations also measured below 10 percent at VMP1-15 and VMP2-15. Radius of influence testing results indicate that the long-term effective treatment area for VW2 will adequately encompass the shallow soil area requiring further soil remediation.

4.2 RECOMMENDATIONS

Continued bioventing treatment of soils at the Davis Site is recommended to further reduce residual concentrations of petroleum hydrocarbons and to reduce contaminant leaching to groundwater. To most effectively accomplish this objective, it is recommended that air injection at VW1 be continued, and that a second blower and air

supply piping be installed for air injection at VW2. For treatment of the shallow, low permeability soils between 5 and 25 feet bgs, a rotary vane compressor/blower should be installed to ensure adequate air delivery at the higher injection pressures that are required.

Annual soil vapor sampling and respiration testing are recommended to monitor remediation progress. Further confirmation soil sampling is not recommended until static oxygen concentrations exceed 5 percent at all VMP screened intervals or respiration/biodegradation rates become asymptotic in the shallow soils.

This results report represents the final deliverable for the Davis Site under the AFCEE Extended Bioventing Project.

SECTION 5

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APPENDIX A
DRAFT WORK PLAN (PARSONS ES, 1998C)

DRAFT

Work Plan for Shallow Soils Investigation/Treatability Testing Davis Global Communications Site

McClellan Air Force Base
California

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas

and

Environmental Management
McClellan Air Force Base, California

December 1998

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DRAFT

WORK PLAN FOR SHALLOW SOILS INVESTIGATION/TREATABILITY TESTING AT DAVIS GLOBAL COMMUNICATIONS SITE

McCLELLAN AFB
DAVIS, CALIFORNIA

DECEMBER 1998

Prepared for:

Air Force Center for Environmental Excellence
Brooks AFB, Texas

and

Environmental Management
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SECTION 1

INTRODUCTION

1.1 SCOPE AND OBJECTIVES

This work plan presents the scope of work to be performed for a soil sampling investigation and treatability testing of shallow, low-permeability, petroleum-hydrocarbon contaminated soils at the Davis Global Communications Site (Davis Site), in Davis, California (The Davis Site is administered by McClellan Air Force Base [AFB]). The primary goal of the proposed activities is to delineate the extent of soil contamination in shallow, low permeability soils and evaluate the applicability of enhanced aerobic biodegradation of petroleum contaminants through air injection exclusively within the shallow soils. Recent site activities indicate that shallow soils located between approximately 10 and 25 feet below ground surface (bgs) continue to exhibit indications of petroleum hydrocarbon contamination following more than 5 years of effective bioventing treatment of deeper site soils. Three main objectives toward achieving this goal are: 1) to assess the extent of shallow soil contamination, 2) to evaluate the potential for supplying oxygen throughout this soil zone utilizing a bioventing treatability test, and 3) to determine design parameters, such as radius of influence, injection pressure, and airflow rates for treatment of shallow soils.

Soil sampling and installation of the bioventing treatability test components will be performed during one site visit. Approximately four soil borings will be installed to evaluate petroleum hydrocarbon contamination in soils south and east of the existing bioventing system and two soil borings will be installed in order to construct a new vent well (VW) and a new vapor monitoring point (VMP) for the treatability test. In

addition, confirmation soil samples will be collected from two locations where soil samples were collected in the past, in order to evaluate the effectiveness of the existing bioventing system. Treatability testing will consist of VW and VMP construction, collection of soil vapor samples, and performance of an air permeability test.

Following completion of field work, information gathered during the shallow soils investigation and bioventing treatability test will be included in a results report. If significant soil contamination is found in shallow soils at the site and the treatability test indicates that the shallow soils will be effectively treated by air injection bioventing, recommendations for bioventing treatment of these soils will be included in the report.

1.2 HISTORICAL SUMMARY OF BIOVENTING APPLICABLE TO THE DAVIS SITE

1.2.1 Bioventing at McClellan AFB

In addition to the existing bioventing system which is effectively treating deeper soils at the Davis Site (Parsons Engineering Science, Inc. [Parsons ES], 1998a), bioventing has been implemented by the Air Force Center for Environmental Excellence (AFCEE) and Parsons ES (formerly Engineering-Science, Inc. [ES]) at six other McClellan AFB sites: Tank Farm #2, Tank Farm #4, SA6, PRL T-46, ST200, and Capehart Gas Station (ES, 1994; AFCEE, 1995; Parsons ES, 1996a; Parsons ES, 1998b). Data from each of these sites has demonstrated the effectiveness of bioventing as a remediation alternative for petroleum hydrocarbon-contaminated soils at McClellan AFB. At these sites, residual hydrocarbon concentrations generally have been reduced by an order of magnitude or more, especially concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) (AFCEE, 1995). At Tank Farm #4, residual concentrations of fuel hydrocarbons in soil have been reduced to non-detect concentrations and concurrence has been received from the lead regulatory agency for No Further Investigation (NFI) Status (California Regional Water Quality Control Board [CRWQCB], 1997). Likewise, preliminary confirmation soil sampling results

for samples collected at Site SA6 in October 1998, indicate that fuel residuals in soil have been significantly reduced through air injection bioventing.

1.2.2 Bioventing in Low Permeability Soils

Initial test data from 145 Air Force sites revealed that bioventing has almost universal application for remediating hydrocarbon-contaminated soils (Parsons ES, 1996b). Successful bioventing has been performed at a wide variety of sites, including sites with fine-grained, low permeability soils. The critical site characteristic for determining bioventing effectiveness at these sites is air permeability in soils. Air permeability is significantly influenced by soil grain size and soil moisture. Sufficient air permeability has been demonstrated at numerous sites with silt and clay contents exceeding 80 percent by weight (Downey *et al.*, 1992). Based on Air Force Site Test Data, excessive soil moisture is likely to represent the greatest limitation to air permeability. A combination of high moisture content and fine-grained soils made bioventing infeasible at only two of the 145 test locations (Parsons ES, 1996b).

Lessons learned from the Air Force Bioventing Initiative project suggest that the feasibility of bioventing at any site should be determined by answering two questions (Parsons ES, 1996b):

- Is the soil sufficiently permeable to provide a minimum of 5 percent oxygen to the contaminated soil volume?
- Is the initial biodegradation rate sufficient to cost effectively reduce contaminants of concern?

Biodegradation rates in the shallow, low permeability soils at the Davis Site have proven sufficient to benefit from enhanced oxygen delivery through air injection bioventing (AFCEE, 1995; Parsons ES, 1998a). However, the first question regarding sufficient air permeability, needs to be further evaluated if site characterization

activities indicate significant petroleum hydrocarbon contamination remains in shallow soils at the Davis Site, and soil remediation is necessary.

1.3 REPORT ORGANIZATION

This work plan consists of seven sections, including this introduction. Section 2 includes a site description, history, and summary of previous investigation and bioventing activities. Section 3 discusses proposed site activities including further delineation of shallow soil contamination, confirmation soil sampling, and bioventing treatability testing. Section 4 discusses Base support requirements. Sections 5 and 6 provide the proposed project schedule and points of contact. References used for preparation of this document are provided in Section 7.

SECTION 2

SITE DESCRIPTION AND HISTORY

2.1 SITE LOCATION AND HISTORY

The Davis Site is located approximately 20 miles southwest of McClellan AFB in Davis, California and occupies approximately 316 acres in a predominantly agricultural area. The location of the Davis Site with respect to McClellan AFB is shown on Figure 2.1. The Davis Site serves as a communications annex for McClellan AFB and is manned 24 hours a day by communication squadron personnel assigned to McClellan AFB. Operational facilities and controls are located within a fenced compound located near the center of the Davis Site. Outside the fence area are more than two dozen antennae and transmitters. Environmental investigations at the site began in 1981 and the site is currently part of the United States (US) Air Force Installation Restoration Program (IRP). Chlorinated volatile organic compounds (VOCs) and petroleum products have been detected in soil, soil vapor, and groundwater at the Davis Site.

Bioventing at the Davis Site is currently being conducted at the former location of three 25,000-gallon underground fuel storage tanks (UFSTs). The UFSTs were located in the southeast portion of the Main Compound Area and were used to store diesel fuel for a generator housed in Building 4710 (Figure 2.2). In February 1985, 52 cubic yards of contaminated soil were removed from above the UFSTs and found to be saturated with petroleum product. The exposed UFSTs showed deformation and the pipelines associated with the UFSTs were found to be leaking. In May 1985, the remaining fuel in the UFSTs was removed and an aboveground diesel fuel storage tank was installed on the north side of Building 4710 to replace the UFSTs. In May 1987, concentrations of trichloroethene (TCE) and tetrachloroethene (a.k.a., perchloroethene

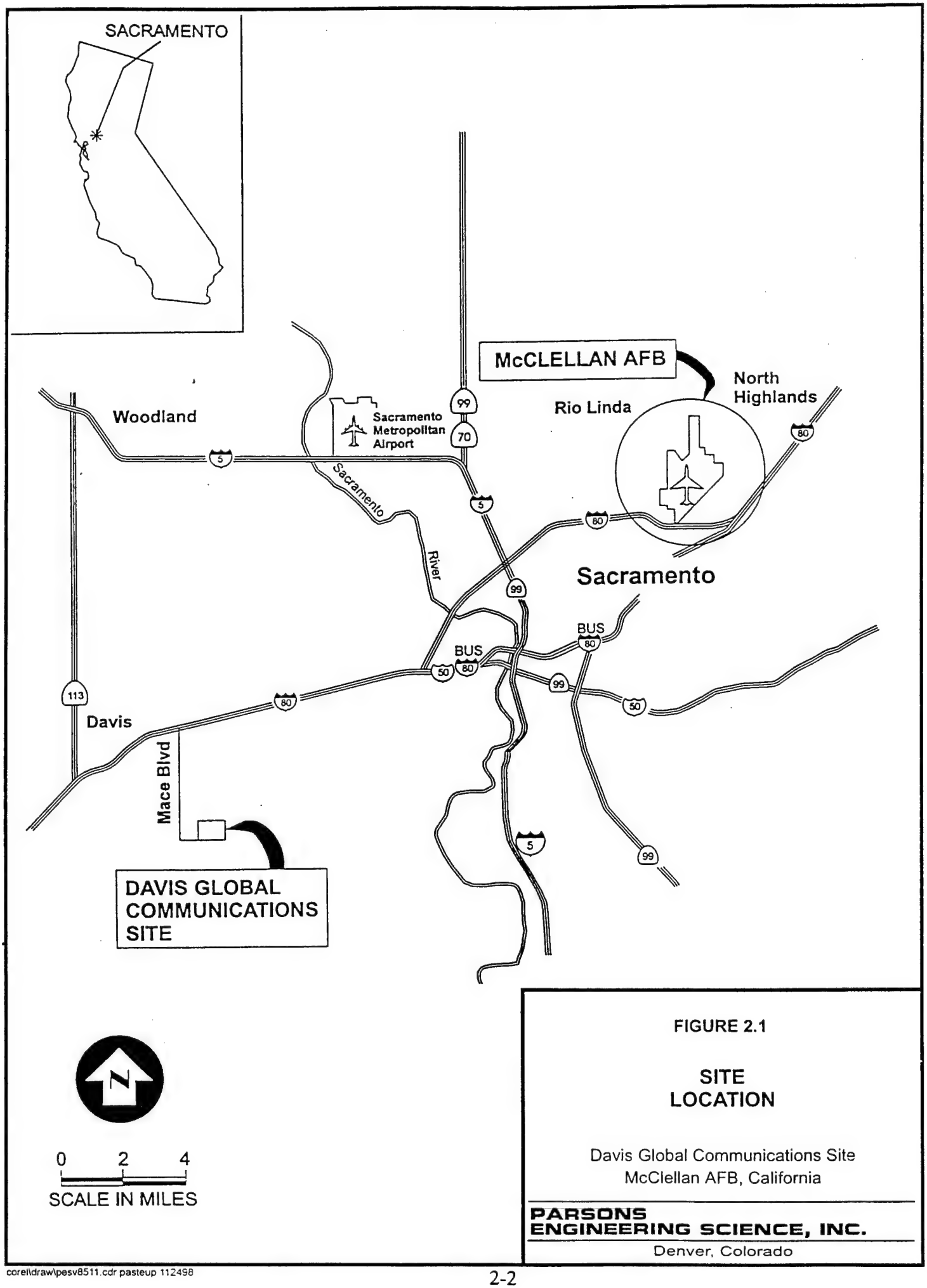

FIGURE 2.1

SITE LOCATION

Davis Global Communications Site
McClellan AFB, California

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Denver, Colorado

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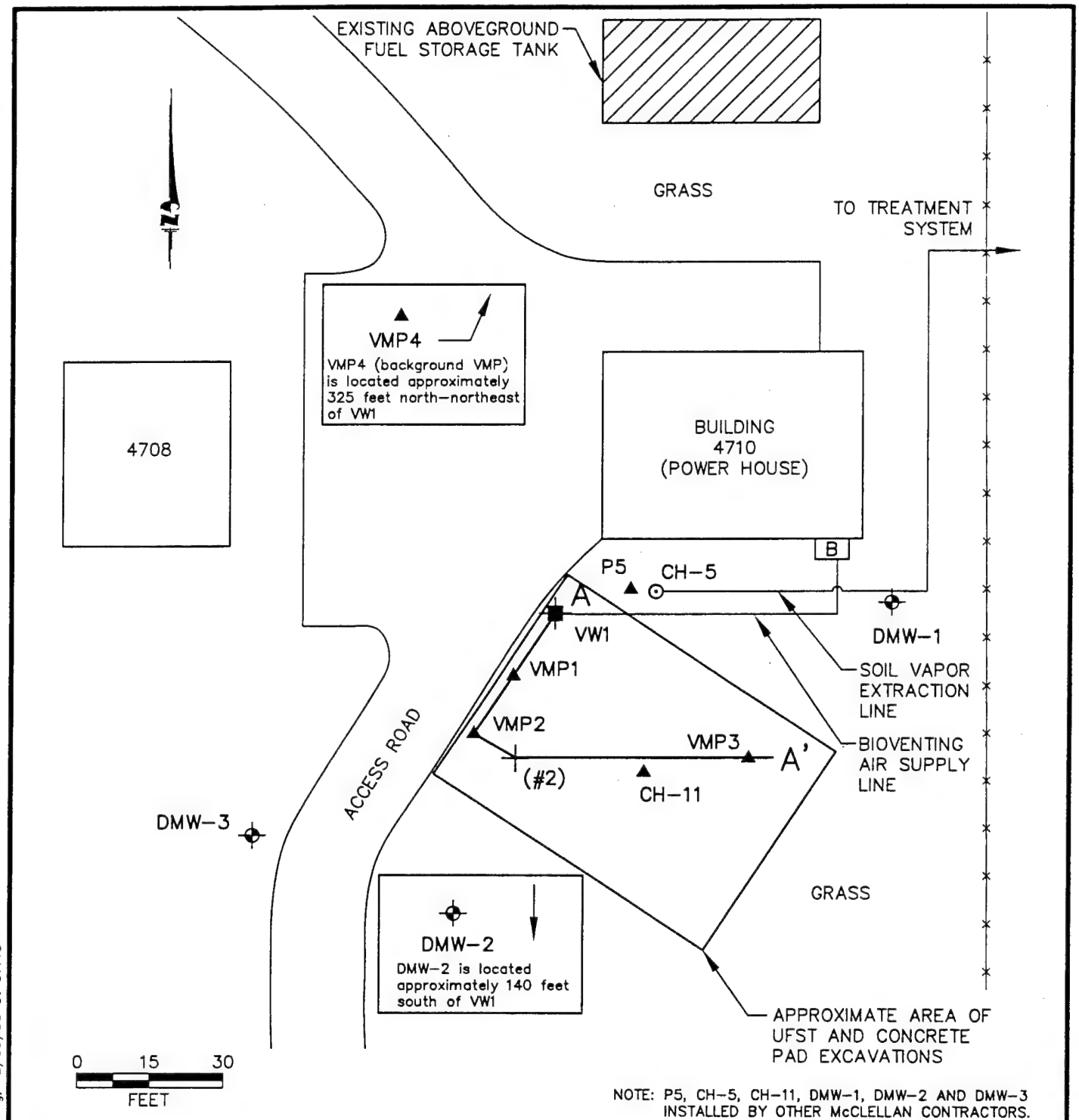

FIGURE 2.2

SITE PLAN

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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[PCE]) exceeding state action levels were detected in groundwater sampled from an on-site production well (the source of the chlorinated VOCs in groundwater was later determined to be unrelated to the UFSTs). In May 1988, the UFSTs were excavated and removed; however, the concrete pad used to anchor the UFSTs was left in place at approximately 13 feet bgs. The UFST excavation above the concrete pad was backfilled with clean soil.

In 1993, Parsons ES installed and performed initial testing of a pilot-scale bioventing system at the Davis Site (ES, 1994). In 1994, Parsons ES performed 1-year confirmation soil and soil vapor sampling to evaluate the effectiveness of approximately 1 year of air injection bioventing treatment (AFCEE, 1995). In 1996, soil vapor extraction (SVE) and groundwater extraction operations were initiated at the Davis Site to remediate chlorinated VOC contamination in groundwater. Also, AFCEE-funded extended operation and maintenance of the pilot-scale bioventing system began. In 1997, Parsons ES performed soil vapor sampling and respiration testing at the end of the monitoring period (Parsons ES, 1998a). Results of the soil vapor sampling and respiration testing indicated that significant petroleum hydrocarbon contamination remained in shallow soils below the former UFSTs and subsurface concrete pad, and that the existing bioventing system was not significantly enhancing bioremediation of these soils.

In September 1998, the subsurface concrete pad and petroleum contaminated soils above and below the pad were removed down to approximately 22 feet bgs. During the excavation activities, soil samples were collected at the base of the excavation. In addition, significant petroleum hydrocarbon contamination was visually observed in soils south and east of the excavation; however, no soil sampling was performed in these locations (Soper, 1998).

2.2 SITE GEOLOGY AND HYDROGEOLOGY

The subsurface lithology of the site in the vicinity of the former UFSTs and concrete pad consists of fill material, below which are laterally continuous intervals of clay,

clayey/silty sand, sand, and gravels. A geologic cross-section of the site based on soil borings advanced during the 1993 pilot-scale bioventing system installation (ES, 1994) is provided as Figure 2.3. It should be noted that the concrete pad shown in Figure 2.3 was removed during soil excavation and removal activities conducted in September 1998 (Section 2.3.4 provides further details).

During the 1993 investigation, a fill material consisting of brown, sandy/clayey silt with minor amounts of gravel was found in the uppermost unit to a depth of between 6 and 13 feet bgs. The native soil present below the UFST fill material was composed of a silty, lean clay to approximately 25 feet bgs. The clays were found to be slightly stiff to stiff in parts exhibiting blue-green discoloration and noticeable fuel odor. From approximately 25 to 30 feet bgs, predominantly clayey sands were encountered. Fine to medium-grained sand was encountered in soil borings from approximately 30 to 35 feet bgs. Below the sand, an approximately 1 foot thick interval of basal gravel was identified. Below this gravel interval, predominantly clayey silts and silty clays were identified to at least a depth of 60 feet bgs (ES, 1994).

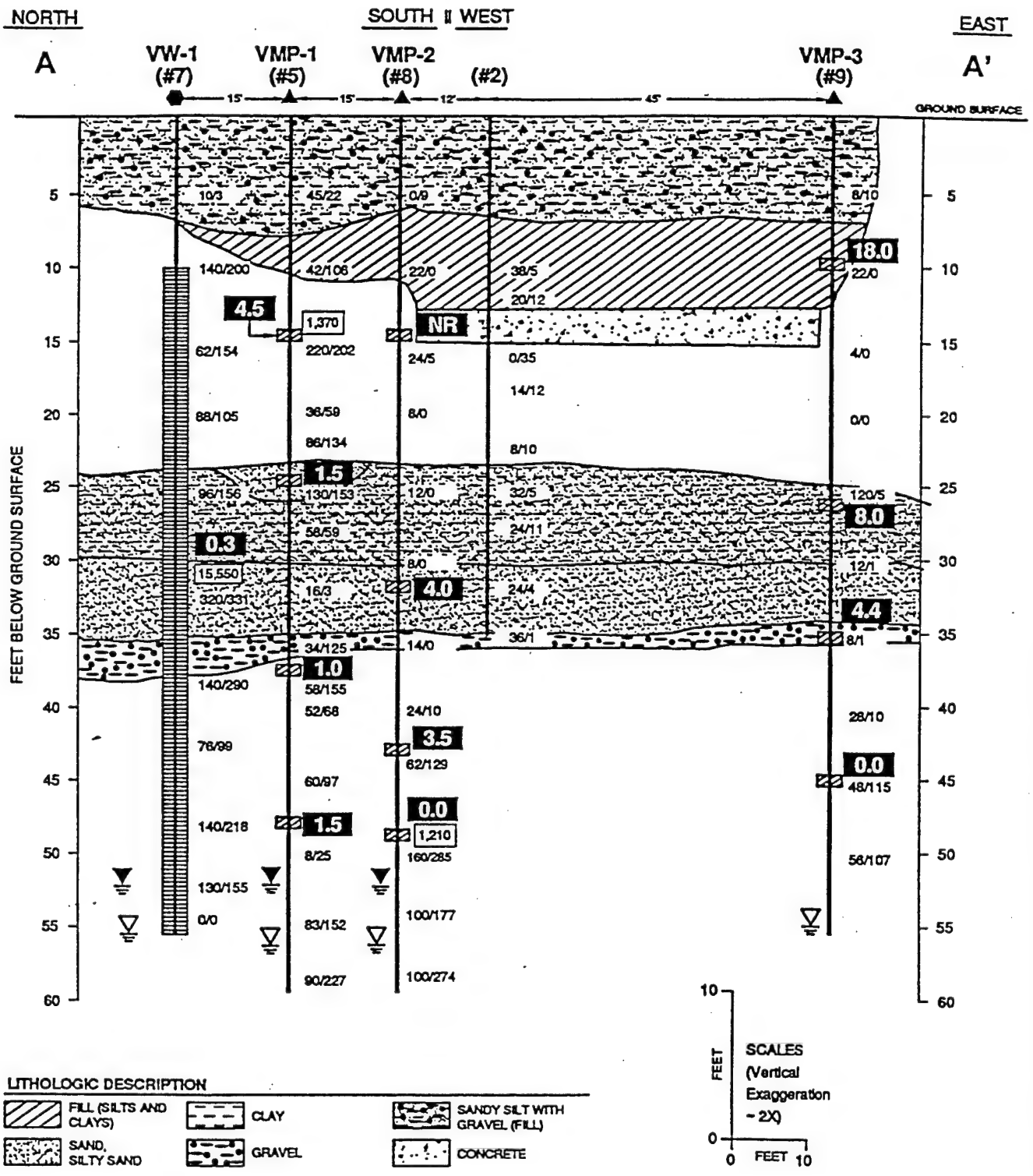
During the July 1993 investigation, groundwater was encountered at approximately 55 feet bgs (ES, 1994); however, seasonal groundwater fluctuations at the Davis Site can be significant. During wet winter/spring months, the typical depth to the groundwater has measured as little as 6 feet bgs (Soper, 1998).

2.3 PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIVITIES

2.3.1 Bioventing Initiative

2.3.1.1 Pilot-Scale Bioventing Installation and Initial Testing

In July/August 1993, Parsons ES installed and performed initial testing of a pilot-scale bioventing system at the Davis Site as part of the AFCEE Bioventing Pilot Test Initiative (Contract No. F33615-90-D-4014, Order 14). The installed pilot-scale bioventing system consisted of one vent well (VW1), three vapor monitoring points (VMP1, VMP2, and VMP3), and one background vapor monitoring point (VMP4)



LITHOLOGIC DESCRIPTION

- FILL (SILTS AND CLAYS)
- CLAY
- SANDY SILT WITH GRAVEL (FILL)
- SAND, SILTY SAND
- GRAVEL
- CONCRETE
- SILTY CLAY, CLAYEY SILT
- CLAYEY/ SILTY SAND

EXPLANATION

- VMP-2 (#1) — VAPOR MONITORING POINT (and Soil Boring Number)
- VW-1 (#1) — VENT WELL (and Soil Boring Number)
- 120/435 — FIELD OVA (SOIL) DATA: THVA/PID (ppm)
- 1,370 — LABORATORY SOIL SAMPLE: TRPH (mg/kg)
- 0.3 — INITIAL O_2 CONCENTRATION IN SOIL GAS (%)
- GEOLOGIC CONTACT
- VMP FILTER PACK (SCREEN) INTERVAL
- VW SCREENED INTERVAL
- EQUILIBRATED WATER LEVEL
- INITIAL WATER LEVEL

Source: ES, 1994.

FIGURE 2.3

GEOLOGIC CROSS-SECTION

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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(Figure 2.2). During the installation of the pilot-scale system, soil and soil vapor sampling and respiration and air permeability testing were performed. Initial soil and soil vapor sampling results for petroleum hydrocarbons are presented in Table 2.1. Following initial testing, a 1.0-horsepower, regenerative blower unit configured for air injection at VW1 was installed for long-term pilot test operation and contaminated soils remediation. A more detailed description of the pilot-scale bioventing system design, installation, and initial testing results are provided in the Bioventing Pilot Test Interim Results Report prepared for this site (ES, 1994).

During installation of the pilot test system, evidence of hydrocarbon contamination was present in all soil boreholes. Blue and/or blue-green discoloration and fuel odors were noted in all boreholes that pen rated native soils beneath the fill. In addition, hydrocarbon contamination was consistently observed at the capillary fringe and in the smear zone created by seasonal groundwater fluctuations. Laboratory analyses of soil samples collected during installation of the VW and VMPs indicated higher concentrations of petroleum hydrocarbons at VW1 than at the VMPs (Table 2.1). In addition, soil sample results from VMP1 at 15 feet bgs indicated that the content of silt/clay and moisture were not excessive, or likely to significantly hamper air injection bioventing treatment of the shallow soils (Table 2.1).

Laboratory analytical results for soil vapor samples collected from the VW and VMPs provided baseline documentation of hydrocarbon contamination and concentrations of BTEX and chlorinated VOCs. Soil vapor analytical results for the Bioventing Initiative are shown in Table 2.1. BTEX compounds and chlorinated VOCs did not exceed 1.2 parts per million, volume per volume (ppmv) for any analyte. These results were consistent with the lower mass fraction of BTEX in diesel fuel compared to other fuels and the determination that the source of the chlorinated VOCs was not the former UFSTs. The maximum detected concentrations of chlorinated VOCs were: 0.017 ppmv 1,2-dichloroethane (1,2-DCA), 0.0091 ppmv *cis*-1,2-

TABLE 2.1
SUMMARY OF BIOVENTING INITIATIVE SOIL AND SOIL VAPOR ANALYTICAL RESULTS
DAVIS GLOBAL COMMUNICATIONS SITE
McCLELLAN AFB, CALIFORNIA

Analyte (Units)[a]			Sample Location-Depth (feet below ground surface)							
			VW1		VMP1-37.5		VMP3-45[e]		VMP2-49	
Soil Gas Hydrocarbons	Units[b]	Method	Initial[c]	1-Year[d]	Initial	1-Year	Initial	1-Year	Initial	1-Year
TPH-jf	ppmv	EPA TO-3	84	22	380	45	270	NS[f]	NS	610
Benzene	ppmv	EPA TO-3	0.005	<0.002[g]	<0.011	<0.002	<0.011	NS	NS	<0.011
Toluene	ppmv	EPA TO-3	<0.002	0.002	<0.011	0.007	<0.011	NS	NS	<0.011
Ethylbenzene	ppmv	EPA TO-3	0.013	0.003	0.55	0.007	0.62	NS	NS	1.6
Xylenes	ppmv	EPA TO-3	0.029	0.065	1.1	0.14	0.88	NS	NS	2.1
1,2-Dichloroethane	ppmv	EPA TO-14	<0.0042	---[h]	<0.0043	---	0.017	NS	NS	---
Benzene	ppmv	EPA TO-14	0.0067	---	<0.0043	---	<0.011	NS	NS	---
cis-1,2-Dichloroethene	ppmv	EPA TO-14	<0.0042	---	0.0091	---	<0.011	NS	NS	---
Ethylbenzene	ppmv	EPA TO-14	0.0072	---	0.011	---	<0.011	NS	NS	---
Freon 113	ppmv	EPA TO-14	0.022	---	0.86	---	0.035	NS	NS	---
Freon 12	ppmv	EPA TO-14	<0.0042	---	0.094	---	<0.011	NS	NS	---
Methylene Chloride	ppmv	EPA TO-14	<0.0042	---	<0.0043	---	<0.011	NS	NS	---
Trichloroethene	ppmv	EPA TO-14	<0.0042	---	0.015	---	<0.011	NS	NS	---
Toluene	ppmv	EPA TO-14	<0.0042	---	0.013	---	<0.011	NS	NS	---
Trimethylbenzenes	ppmv	EPA TO-14	0.0247	---	0.023	---	<0.011	NS	NS	---
Vinyl Chloride	ppmv	EPA TO-14	0.0051	---	<0.0043	---	<0.011	NS	NS	---
Xylenes	ppmv	EPA TO-14	0.031	---	0.052	---	0.013	NS	NS	---

			VW1-32.5		VMP1-15		VMP2-50	
Soil Hydrocarbons			Initial[i]	1-Year[j]	Initial	1-Year	Initial	1-Year
TRPH	mg/kg	E418.1	15,500	3,150	1,370	330	1,210	90.8
Benzene	mg/kg	SW8020	<0.4	<0.061	<0.2	<0.059	<0.2	<0.061
Toluene	mg/kg	SW8020	<0.4	<0.061	<0.2	<0.059	<0.2	<0.061
Ethylbenzene	mg/kg	SW8020	<0.4	<0.061	<0.2	<0.059	<0.2	0.170
Xylenes	mg/kg	SW8020	<0.7	<0.120	<0.4	<0.120	<0.4	0.190

			VW1-32.5		VMP1-15		VMP2-50	
Soil Physial Parameters			Initial[i]	1-Year[j]	Initial	1-Year	Initial	1-Year
Moisture Content	(% by wt.)	ASTM D2216	17	---	18	---	20	---
Gravel	(% by wt.)	ASTM D2216	0.2	---	2.1	---	0	---
Sand	(% by wt.)	ASTM D2216	81.8	---	32.5	---	0.8	---
Silt	(% by wt.)	ASTM D2216	12.8	---	44.6	---	61.1	---
Clay	(% by wt.)	ASTM D2216	5.3	---	20.8	---	38	---

[a] TPH-jf = total petroleum hydrocarbons referenced to jet fuel; TRPH=total recoverable petroleum hydrocarbons.

[b] ppmv = parts per million, volume per volume; mg/kg = milligrams per kilogram.

[c] Initial soil vapor samples collected on 8/16/93, 8/17/93, and 8/27/93.

[d] 1-Year soil vapor samples collected on 9/26/94.

[e] Soils were too tight to collect 1-year soil gas sample; 1-year sample collected instead from closest monitoring point VMP2-49.

[f] NS = Not sampled.

[g] < and gray shading indicate compound analyzed for but not detected. Number shown represents the laboratory reporting limit.

[h] --- = not analyzed.

[i] Initial soil samples collected on 7/21/93 and 7/22/93.

[j] 1-Year soil samples collected on 9/30/94.

dichlorethene (*cis*-1,2-DCE), 0.86 ppmv Freon 113, 0.094 ppmv Freon 12, 0.015 ppmv TCE, and 0.0051 ppmv vinyl chloride (ES, 1994).

Two air permeability tests were conducted in August 1993 to determine whether site soils were sufficiently permeable for air injection bioventing treatment. During the first test, well-head pressures exceeding 210 inches of water (in. H_2O) were measured, but little pressure response was indicated at the VMP screened intervals. It was suspected that the VW1 borehole was smeared with wet clay during well construction; therefore, the blower was left running for approximately 19 hours to dry out the borehole. After 19 hours of air injection, a second air permeability test was performed and the average well-head pressure was reduced to 50 in. H_2O. However, pressure responses at all VMPs remained very low possibly due to preferential air flow within the more permeable sand interval (Figure 2.3) or residual effects of the borehole smearing at VW1. Permeability values typical of clayey soils (1.5 to 2 darcys) were calculated based on data collected during the second air permeability test (ES, 1994).

During the second air permeability test, changes in soil vapor oxygen levels were measured at the VMP screened intervals to determine the radius of oxygen influence resulting from air injection into VW1. Following 2 weeks of air injection into VW1, oxygen increases were observed at all VMP screened intervals except VMP3-10. Based on these results, the long-term radius of oxygen influence was expected to exceed 55 feet.

2.3.1.2 One-Year Testing

As part of the AFCEE Bioventing Initiative project, the pilot-scale bioventing system was operated for 1 year prior to collecting confirmation soil and soil vapor samples. The 1-year sampling event was performed in September 1994 following 1 month of system shut down to allow soil and soil vapor to return to equilibrium conditions for comparison to initial data. Sampling results from the 1-year event are provided in Table 2.1. Following 1-year testing, the blower system was restarted to continue bioventing treatment of site soils.

While limited soil data was collected during the initial and 1-year sampling events, petroleum hydrocarbon contamination in soils, measured as total recoverable petroleum hydrocarbons (TRPH), was reduced on average by 83 percent. Similar reductions were evident in soil vapor total petroleum hydrocarbon (TPH) concentrations at VW1 and VMP1-37.5, where initial and 1-year sampling was performed. Soil and soil vapor concentrations of BTEX remained at non-detect or near non-detect levels. Further detail of the 1-year sampling event results are provided in the AFCEE (1995) memorandum to McClellan AFB.

2.3.2 Soil Vapor Extraction and Groundwater Extraction

In June 1996, soil vapor extraction (SVE) and groundwater extraction operations were initiated at the Davis Site as part of remediation efforts for the TCE contamination in groundwater. The SVE system is being operated by OHM Remediation Services under AFCEE Contract F41624-94-D-8106, Order 15. One of the wells used for SVE, CH-5, is located near the bioventing pilot test area (Figure 2.2). Therefore, since June 1996, the contaminated soils have been undergoing a combination of air injection at VW1 and air extraction at CH-5. CH-11, a soil vapor monitoring point installed in August of 1996, also is being used to monitor the performance of the SVE system.

Groundwater monitoring results for the first quarter of 1997 (Radian, 1997) indicated that the groundwater beneath the former UFST excavation is within the capture zone of the operating groundwater extraction system. Chlorinated VOCs unrelated to the former UFSTs continue to drive the groundwater extraction and remediation effort at the Davis Site. During the first quarter of 1997, the maximum TCE, PCE, and 1,1-DCE concentrations in samples collected from downgradient monitoring wells were 10.8 micrograms per liter (μg/L), 74.7 μg/L, and 6.14 μg/L, respectively. BTEX compounds in the nearest downgradient monitoring wells (DMW-2 and DMW-3) were below maximum contaminant levels (MCLs) for drinking water.

2.3.3 Extended Bioventing

Results of the 1-year bioventing pilot test demonstrated that *in situ* bioventing was an effective method to remediate vadose zone soils at the Davis Site by aerobically enhancing biological fuel degradation. Based on the favorable bioventing pilot testing results at the Davis Site, funding was allocated by AFCEE under the Extended Bioventing project for bioventing system maintenance with year-end respiration testing and soil vapor sampling (Option 1). In anticipation of favorable extended bioventing system results, AFCEE also provided funding for confirmatory soil sampling and site closure (Option 2), if appropriate.

The 1-year of AFCEE-funded maintenance and monitoring of the bioventing system began in June 1996. In June 1997, oxygen influence measurements were taken to determine the effectiveness of the blower in providing oxygen to the contaminated soils. Following these measurements, the bioventing system was shut down in preparation for Option 1 soil vapor sampling and respiration testing. In addition, air extraction from SVE wells near the bioventing site was shut off to allow equilibrium conditions to develop in site soil and soil vapor so that Option 1 results could be compared to previous results. The Option 1 sampling event was performed between 21 and 24 July 1997, following more than 4 years of pilot-scale bioventing system operation and approximately 1 month of system shutdown. Results of the sampling event were provided to AFCEE and McClellan AFB by Parsons ES (1998a) in a 2 March 1998 letter and are summarized in the following sections.

2.3.3.1 Soil Vapor Chemistry Results

Soil vapor chemistry results from the Option 1 sampling event, including field screening measurements of oxygen, carbon dioxide, and total volatile hydrocarbons (TVH) and analytical results for soil vapor samples, are provided in Table 2.2 along with previous soil vapor sampling results.

TABLE 2.2

4-YEAR SUMMARY OF SOIL VAPOR FIELD SCREENING AND TPH AND BTEX ANALYTICAL RESULTS

DAVIS GLOBAL COMMUNICATIONS SITE

McCLELLAN AFB, CALIFORNIA

				Field Screening Data			Laboratory Analytical Data[a/]				
Sample Location	Sample Depth (ft bgs)[b/]	Sampling Event[c/]	Blower Status	O_2 (%)	CO_2 (%)	TVH[d/] (ppmv)[f/]	TPH-jf[e/] (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Total Xylenes (ppmv)
VW1	10-55	Initial	Off	0.3	4.0	NS[g/]	84	0.0067	<0.002[h/]	0.013	0.031
		1-Year	Off	0.0	5.0	40	22	<0.002	0.002	0.003	0.065
		4-Year	Off	18.5	0.5	47	12	0.031	0.006	0.022	0.088
VMP1	15	Initial	Off	4.5	1.2	110	---[i/]	---	---	---	---
		3-Week	On	11.5	NS	NS	---	---	---	---	---
		6-Month	On	4.0	>5[j/]	50	---	---	---	---	---
		1-Year	Off	6.2	9.8	100	---	---	---	---	---
		2-Year	On	<3.5	12.0	NS	---	---	---	---	---
		3-Year	On	3.0	9.0	NS	---	---	---	---	---
		4-Year	On	4.0	11.3	NS	---	---	---	---	---
		4-Year	Off	4.0	NS	NS	550	0.19	0.40	0.49	1.6
VMP1	25	Initial	Off	1.5	3.7	230	---	---	---	---	---
		3-Week	On	13.5	NS	NS	---	---	---	---	---
		6-Month	On	20.2	0.30	8	---	---	---	---	---
		1-Year	Off	1.0	5.4	40	---	---	---	---	---
		2-Year	On	20.0	1.0	45	---	---	---	---	---
		3-Year	On	19.8	1.2	25	---	---	---	---	---
		4-Year	On	20.0	1.1	32	---	---	---	---	---
		4-Year	Off	0.5	1.6	140	---	---	---	---	---
VMP1	37.5	Initial	Off	1.0	6.3	140	380	<0.011	0.013	0.55	1.1
		3-Week	On	18.0	NS	NS	---	---	---	---	---
		6-Month	On	F[k/]	F	F	---	---	---	---	---
		1-Year	Off	1.8	3.5	64	45	<0.002	0.007	0.007	0.14
		2-Year	On	F	F	F	---	---	---	---	---
		3-Year	On	20.2	0.8	22	---	---	---	---	---
		4-Year	On	20.5	0.8	20	---	---	---	---	---
		4-Year	Off	4.0	4.5	46	61	<0.002	<0.002	0.024	0.021
							(34)[l/]	(<0.002)	(0.006)	(0.015)	(0.088)
VMP1	48	Initial	Off	1.5	6.5	340	---	---	---	---	---
		3-Week	On	9.0	NS	NS	---	---	---	---	---
		6-Month	On	F	F	F	---	---	---	---	---
		1-Year	Off	1.2	6.2	180	---	---	---	---	---
		2-Year	On	F	F	F	---	---	---	---	---
		3-Year	On	F	F	F	---	---	---	---	---
		4-Year	On	F	F	F	---	---	---	---	---
		4-Year	Off	F	F	F	---	---	---	---	---
VMP2	15	Initial	Off	NS	NS	NS	---	---	---	---	---
		3-Week	On	NS	NS	NS	---	---	---	---	---
		6-Month	On	NS	NS	NS	---	---	---	---	---
		1-Year	Off	1.5	7.8	50	---	---	---	---	---
		2-Year	On	13.0	6.5	120	---	---	---	---	---
		3-Year	On	17.5	3.9	50	---	---	---	---	---
		4-Year	On	10.5	6.0	88	---	---	---	---	---
		4-Year	Off	5.0	3.7	66	140	<0.002	0.036	0.11	0.32

TABLE 2.2 (Continued)

4-YEAR SUMMARY OF SOIL VAPOR FIELD SCREENING AND TPH AND BTEX ANALYTICAL RESULTS

DAVIS GLOBAL COMMUNICATIONS SITE

McCLELLAN AFB, CALIFORNIA

Sample Location	Sample Depth (ft bgs)[b]	Sampling Event[c]	Blower Status	Field Screening Data			Laboratory Analytical Data[a]				
				O_2 (%)	CO_2 (%)	TVH[d] (ppmv)[f]	TPH-jf[e] (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Total Xylenes (ppmv)
VMP2	32	Initial	Off	4.0	7.8	97	---	---	---	---	---
		3-Week	On	20.5	NS	NS	---	---	---	---	---
		6-Month	On	F	F	F	---	---	---	---	---
		1-Year	Off	14.8	0.6	48	---	---	---	---	---
		2-Year	On	20.0	0.5	10	---	---	---	---	---
		3-Year	On	20.5	0.5	22	---	---	---	---	---
		4-Year	On	20.8	0.3	2	---	---	---	---	---
		4-Year	Off	17.5	0.5	230	---	---	---	---	---
VMP2	43	Initial	Off	3.5	6.0	90	---	---	---	---	---
		3-Week	On	18.0	NS	NS	---	---	---	---	---
		6-Month	On	F	F	F	---	---	---	---	---
		1-Year	Off	20.0	0.0	---	---	---	---	---	---
		2-Year	On	F	F	F	---	---	---	---	---
		3-Year	On	F	F	F	---	---	---	---	---
		4-Year	On	F	F	F	---	---	---	---	---
		4-Year	Off	20.5	0.2	NS	---	---	---	---	---
VMP2	49	Initial	Off	0.0	6.8	370	---	---	---	---	---
		3-Week	On	F	F	F	---	---	---	---	---
		6-Month	On	F	F	F	---	---	---	---	---
		1-Year	Off	1.0	7.7	220	610	<0.011	<0.011	1.6	2.1
		2-Year	On	F	F	F	---	---	---	---	---
		3-Year	On	F	F	F	---	---	---	---	---
		4-Year	On	F	F	F	---	---	---	---	---
VMP3	10	Initial	Off	18.0	1.4	46	---	---	---	---	---
		3-Week	On	7.5	NS	NS	---	---	---	---	---
		6-Month	On	20.8	1.2	4	---	---	---	---	---
		1-Year	Off	14.0	4.5	30	---	---	---	---	---
		2-Year	On	18.5	3.2	85	---	---	---	---	---
		3-Year	On	18.2	2.5	38	---	---	---	---	---
		4-Year	On	19.8	2.5	48	---	---	---	---	---
		4-Year	Off	9.5	3.0	30	---	---	---	---	---
VMP3	26.5	Initial	Off	8.0	5.8	67	---	---	---	---	---
		3-Week	On	17.0	NS	NS	---	---	---	---	---
		6-Month	On	20.1	0.8	2	---	---	---	---	---
		1-Year	Off	11.3	1.0	20	---	---	---	---	---
		2-Year	On	19.2	2.2	70	---	---	---	---	---
		3-Year	On	20.0	1.8	30	---	---	---	---	---
		4-Year	On	20.1	1.7	35	---	---	---	---	---
		4-Year	Off	15.0	1.6	30	---	---	---	---	---
VMP3	35	Initial	Off	4.4	7.7	76	---	---	---	---	---
		3-Week	On	19.0	NS	NS	---	---	---	---	---
		6-Month	On	F	F	F	---	---	---	---	---
		1-Year	Off	4.1	3.2	28	---	---	---	---	---
		2-Year	On	F	F	F	---	---	---	---	---
		3-Year	On	18.0	1.8	30	---	---	---	---	---
		4-Year	On	19.7	2.3	45	---	---	---	---	---
		4-Year	Off	13.1	2.4	70	6.2	<0.002	<0.002	0.003	0.015

TABLE 2.2 (Continued)

4-YEAR SUMMARY OF SOIL VAPOR FIELD SCREENING AND TPH AND BTEX ANALYTICAL RESULTS

DAVIS GLOBAL COMMUNICATIONS SITE

McCLELLAN AFB, CALIFORNIA

				Field Screening Data			Laboratory Analytical Data[a]				
Sample Location	Sample Depth (ft bgs)[b]	Sampling Event[c]	Blower Status	O_2 (%)	CO_2 (%)	TVH[d] (ppmv)[f]	TPH-jf[e] (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Total Xylenes (ppmv)
VMP3	45	Initial	Off	0.0	4.6	160	270	<0.011	<0.011	0.62	0.88
		3-Week	On	15.0	NS	NS	---	---	---	---	---
		6-Month	On	F	F	F	---	---	---	---	---
		1-Year	Off	NS	NS	NS	---	---	---	---	---
		2-Year	On	F	F	F	---	---	---	---	---
		3-Year	On	F	F	F	---	---	---	---	---
		4-Year	Off	F	F	F	---	---	---	---	---
P5-S	18-20	Inital	Off	21.0	0.25	0	---	---	---	---	---
		6-Month	On	20.8	0.0	0	---	---	---	---	---
		1-Year	Off	20.8	0.0	18	---	---	---	---	---
		4-Year	On	20.8	0.40	18	---	---	---	---	---
		4-Year	Off	20.7	0.0	0	---	---	---	---	---
P5-D	45-55	Initial	Off	9.5	7.5	800	---	---	---	---	---
		6-Month	On	20.8	0.80	0	---	---	---	---	---
		1-Year	Off	20.0	0.50	60	---	---	---	---	---
		4-Year	On	20.8	0.25	0	---	---	---	---	---
		4-Year	Off	20.7	0.0	0	---	---	---	---	---
CH-5	28-38	Initial	Off	0.0	8.5	350	---	---	---	---	---
		6-Month	On	20.1	0.70	8	---	---	---	---	---
		1-Year	Off	0.5	5.8	56	---	---	---	---	---
CH-11	20.4	3-Year	On	20.0	0.40	330	---	---	---	---	---
		4-Year	On	8.8	0.75	12	---	---	---	---	---
		4-Year	Off	12.2	0.50	40	3.2	<0.0024	0.0066	<0.0024	0.0083
CH-11	36	3-Year	On	20.0	0.70	12	---	---	---	---	---
		4-Year	On	20.5	0.75	22	---	---	---	---	---
		4-Year	Off	13.2	2.0	50	2.5	0.0012	0.0044	0.0011	0.0057

[a] Laboratory analysis of soil vapor samples included both USEPA Methods TO-3 and TO-14. Where both analyses were performed, the maximum concentrations are shown

[b] ft bgs = feet below ground surface.

[c] Soil vapor sampling was performed in August 1993 (Initial), September 1993 (3-Week), March 1994 (6-Month), September 1994 (1-Year), November 1995 (2-Year), August 1996 (3-Year), June 1997 (4-Year; blower on), and July 1997 (4-Year; blower off).

[d] TVH = total volatile hydrocarbons.

[e] TPH-jf = total petroleum hydrocarbons referenced to jet fuel (MW = 156)

[f] ppmv = parts per million by volume.

[g] NS = not sampled (usually because soils were too tight for adequate sample purge or volume).

[h] < and gray shading indicate compound analyzed for but not detected. Number shown represents the laboratory reporting limit.

[i] --- = not analyzed.

[j] > = field measurement exceeding maximum meter reading shown.

[k] F = screen was flooded (below groundwater).

[l] Field duplicate results shown in parentheses.

Oxygen influence measurements collected in June 1997, and during earlier monitoring events when the bioventing and SVE systems have been operating, indicate that air injection/extraction activities have been successful in aerating the more permeable site soils located greater than 25 feet bgs. Oxygen influence measurements at the 15-foot screened intervals of VMP1 and VMP2 and the 20.4-foot screened interval of CH-11 indicate that air injection has been less effective in the silty clay soils located between 13 and 25 feet bgs. With the exception of these shallow VMP screened intervals, oxygen concentrations greater than 19 percent were measured in June 1997 field screening samples collected while air injection/extraction activities were occurring. The lower effectiveness of air injection observed in the upper clays is likely the result of a combination of tighter soils in this formation, higher moisture contents, and preferential VW air flow to the deeper, more permeable soils located greater than 25 feet bgs.

During the July 1997 sampling event, equilibrium soil vapor oxygen concentrations were less than or equal to 5 percent at the 15-, 25-, and 37.5-foot screened intervals of VMP1 and the 15-foot screened interval of VMP2. Depleted equilibrium oxygen concentrations at the 15-foot depths of VMP1 and VMP2 resulted from the inability to effectively aerate shallow soils above 25 feet bgs by air injection into VW1. Depleted static oxygen values at VMP1-25 and VMP1-37.5 resulted from the presence of residual petroleum contamination in these soils that continues to exert some oxygen demand. Static oxygen concentrations at all other sampled locations were greater than 9 percent; however, soil vapor samples could not be collected from all previously sampled locations, because groundwater was present at approximately 43 feet bgs.

During the Option 1 sampling event, soil vapor samples also were collected for laboratory analysis at VW1, VMP1-15, VMP1-37.5, VMP2-15, and VMP3-35 and the 20.4- and 36-foot screened intervals at CH-11. Samples were submitted to Air Toxics, Ltd. in Folsom, California, and analyzed for TPH referenced to jet fuel (TPH-jf) and BTEX using US Environmental Protection Agency (USEPA) Method TO-3. July 1997

results for TPH-jf and BTEX are provided in Table 2.2 along with analytical results from earlier sampling events. Analytical results were consistent with the field screening results, with both TPH-jf and BTEX concentrations highest in shallow soils at VMP1. Good correlation appeared to exist between soil vapor concentrations and oxygen concentrations, indicating that oxygen concentrations were an effective indicator of remediation progress.

2.3.3.2 Respiration Testing Results

After the completion of Option 1 soil vapor sampling, an *in situ* respiration test was performed according to procedures outlined in the AFCEE bioventing protocol document (Hinchee *et al.*, 1992). Air was injected at approximately 1 cubic foot per minute (cfm) for 20 hours to locally oxygenate the soils at VMP1-25, VMP1-37.5, VMP2-15, and VMP3-35. Following the air injection period, changes in soil vapor oxygen, carbon dioxide, and TVH concentrations were monitored over a 52-hour period. Observed rates of oxygen utilization were then used to estimate aerobic fuel biodegradation rates. Table 2.3 presents the results of July 1997 respiration testing along with previous respiration testing results.

The highest oxygen utilization rates were measured in soils between 15 and 25 feet bgs at VMP1 and VMP2. Oxygen utilization rates of 0.035 percent per minute (2.1 percent per hour) and 0.0074 percent per minute (0.44 percent per hour) were measured at VMP2-15 and VMP1-25, respectively. Previous respiration testing results are not available for comparison at VMP2-15; however, 4-year oxygen utilization rates at VMP1-37.5 and VMP3-35 were approximately 40 percent less than those measured in August 1993 prior to bioventing system startup. Oxygen utilization rates and corresponding fuel biodegradation rates at VMP1-25 were less than rates measured following 1-year of bioventing, but greater than the initial and 6-month values. Oxygen utilization rates at VMP1-25 and VMP2-15 indicated that a significant amount of fuel hydrocarbons remained below the concrete pad in the low permeability soils between 13 and 25 feet bgs. Although oxygen utilization rates appeared to have

TABLE 2.3
4-YEAR SUMMARY OF RESPIRATION AND FUEL BIODEGRADATION RATES
DAVIS GLOBAL COMMUNICATIONS SITE
McCLELLAN AFB, CALIFORNIA

Location	Depth (ft bgs)[a]	Initial (August 1993)			6-Month (March 1994)			1-Year (September 1994)			4-Year (July 1997)		
		K_o[b] ($\%O_2$/min)	Degradation Rate (mg/kg/yr)[c]	Soil Temp.[d] (°C)	K_o ($\%O_2$/min)	Degradation Rate[e] (mg/kg/yr)	Soil Temp. (°C)	K_o ($\%O_2$/min)	Degradation Rate (mg/kg/yr)	Soil Temp. (°C)	K_o ($\%O_2$/min)	Degradation Rate[f] (mg/kg/yr)	Soil Temp. (°C)
VW1	10-55	NC[g]	NC	---[h]	0.000010	< 10	---	NC	NC	---	NC	NC	---
VMP1	15	0.0028	250	18.8	NC	NC	20.2	NC	NC	23.6	NC	NC	20.0
	25	0.0060	620	---	0.0062	720	---	0.0097	1,200	---	0.0074	1,030	---
	37.5	0.0077	160	---	NC	NC	---	0.010	500	---	0.0044	210	---
	48	0.0063	690	18.7	NC	NC	19.0	0.013	1,700	20.4	NC	NC	21.8
VMP2	15	NC	NC	---	NC	NC	---	NC	NC	---	0.035	3,630	---
	32	0.0015	100	---	NC	NC	---	NC	NC	---	NC	NC	---
	43	0.0037	260	---	NC	NC	---	NC	NC	---	NC	NC	---
	49	0.020	1,100	---	NC	NC	---	0.050	4,200	---	NC	NC	---
VMP3	10	NC	NC	---	0.00027	20	---	NC	NC	---	NC	NC	---
	26.5	0.0040	270	---	0.00012	10	---	NC	NC	---	NC	NC	---
	35	0.0033	350	---	NC	NC	---	0.0035	440	---	0.0019	250	---
	45	0.0067	450	---	NC	NC	---	NC	NC	---	NC	NC	---
P5-S	18-20	NC	NC	---	0	0	---	NC	NC	---	NC	NC	---
P5-D	45-55	NC	NC	---	NC	NC	---	0.0047	440	---	NC	NC	---
CH-5	28-38	NC	NC	---	0.0058	680	---	NC	NC	---	NC	NC	---

[a] ft bgs = feet below ground surface.

[b] K_o = oxygen utilization rate in percent oxygen per minute.

[c] mg/kg/yr = milligrams of hydrocarbons per kilogram of soil per year.

[d] Soil temperature in degrees Celsius.

[e] 6-month biodegradation calculations utilized average soil moisture results from the initial and 1-year sampling events.

[f] 4-year biodegradation calculations utilized soil moisture results from the 1-year sampling event.

[g] NC = not calculated (soils were either not oxygenated during the respiration test or location was below groundwater).

[h] --- = not measured (thermocouple not installed at this location)

decreased, 4-year respiration testing results indicated that fuel biodegradation could be further enhanced if air injection bioventing could be made more effective in the shallow soils located between 10 and 25 feet bgs.

2.3.3.3 Option 1 Results Summary

The results of the Option 1 testing event indicated that petroleum hydrocarbons remained in site soils, especially the shallow, clay-rich soils. Oxygen influence measurements following more than 4 years of bioventing continued to indicate that these soils were not being effectively aerated by the existing bioventing system. System monitoring data suggested that residual soil contamination in these shallower soils is continuing to act as a source of contamination for infiltrating recharge and during times of elevated groundwater conditions and contact with these shallow, petroleum-contaminated soils.

Nevertheless, air injection at VW1 appeared to be effectively aerating and enhancing bioremediation of petroleum hydrocarbon-contaminated soils greater than 25 feet bgs, including smear zone soils, and to a lesser extent more shallow soils at VMP2. Continued air injection into the deeper soils could be expected to provide some degree of protection for groundwater when the groundwater is not in direct contact with the shallow, petroleum-contaminated soils. The data indicates that although petroleum contamination still exists at the Davis Site, the risk-driving BTEX compounds are present at non-detect or near non-detect concentrations in both soil and soil vapor.

2.3.4 Concrete Pad Removal

In September 1998, the concrete pad used to anchor the former UFSTs was removed. During the excavation, petroleum-contaminated soils above and beneath the pad also were removed and transported to the Davis Site soil stockpile. The total depth of the excavation was approximately 22 feet bgs. Following removal of the concrete pad and removal of petroleum-contaminated soils, clean excavated soils were mixed with clean fill and returned to the excavation. The existing bioventing system

components, including VW1, subsurface air piping, and VMP1, VMP2, and VMP3, were left in place during soil excavation activities and not damaged. Monitoring point CH-11 was damaged during excavation activities, but was repaired (Soper, 1998).

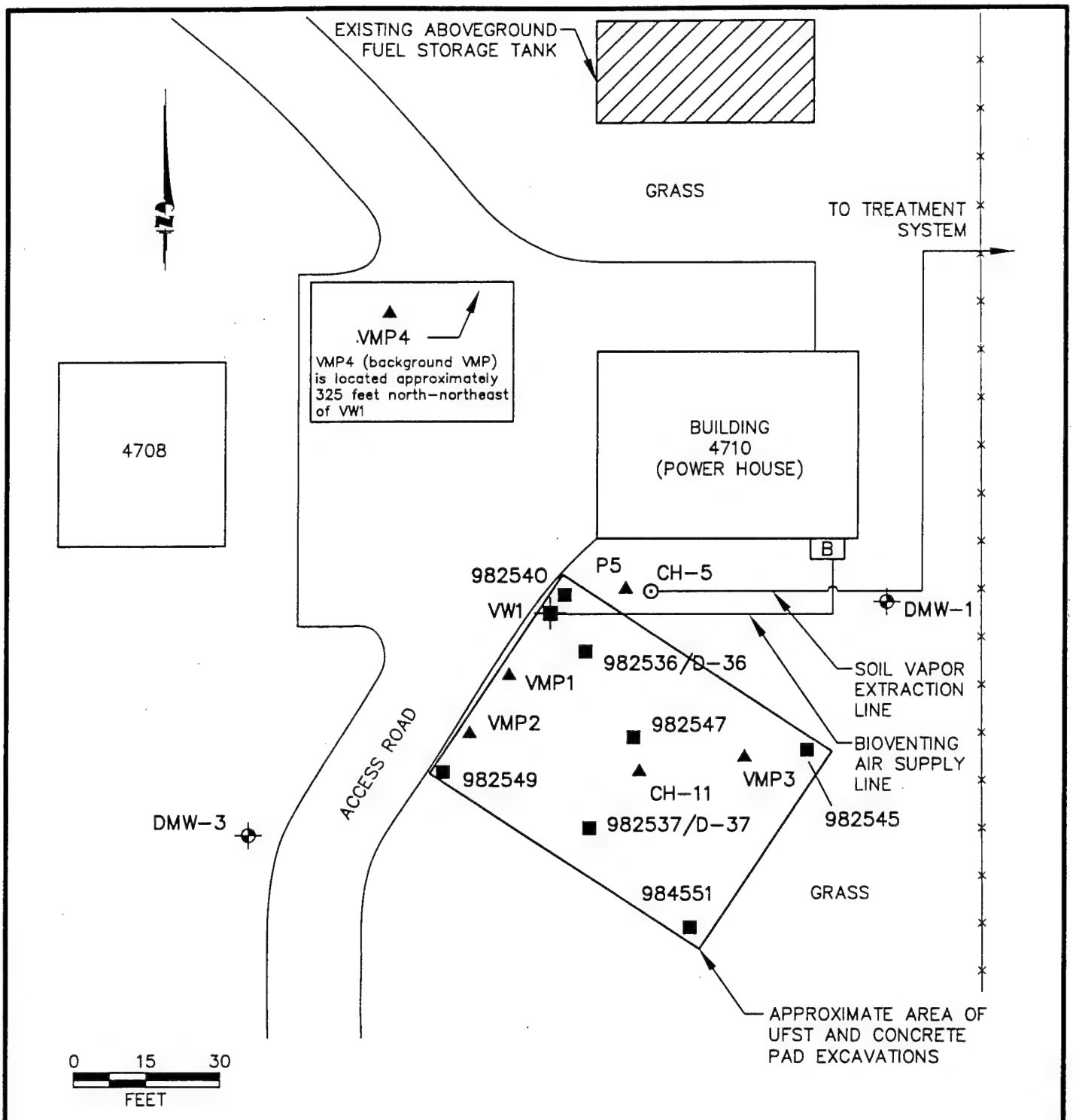
Seven soil samples were collected during excavation activities and submitted for laboratory analysis of total TPH as diesel (TPH-d), total TPH as gasoline (TPH-g), BTEX, VOCs, and semivolatile organic compounds (SVOCs). Two samples (982536/D-36 and 982537/D-37) were submitted from soils originally located above the concrete pad at approximately 10 feet bgs. The remaining five samples (982540, 982545, 982547, 982549, and 982551) were collected from the bottom of the excavation pit at approximately 22 feet bgs. Soil sampling locations are shown on Figure 2.4 and sample results are provided in Table 2.4.

Soil sample results for soils collected above the concrete pad at 10 feet bgs (982536/D-36 and 982537/D-37) confirmed the Option 1 testing results that indicated residual petroleum contamination (exceeding 1,000 mg/kg) was still present in the shallow low permeability soils and these soils were not benefiting significantly from air injection at VW1. Considerably less petroleum hydrocarbon contamination was evident in soil samples collected from the base of the excavation pit. The average TPH-d concentration in samples collected at this depth was approximately 16 mg/kg. The data also confirmed that BTEX concentrations in site soils are insignificant.

During soil excavation activities, visual evidence of contamination was observed in adjoining soils to the south and east of the main excavation. Minor excavations were made in these areas, but the areal extent of contamination could not be delineated. No soil samples were collected from these areas, but visual evidence suggested petroleum concentrations may be similar to those observed in the samples collected at 10 feet bgs.

2.3.5 Summary

During the excavation and removal of the concrete pad, shallow, petroleum hydrocarbon-contaminated soils also were removed down to approximately 22 feet bgs.



LEGEND

VW1	⊕	AIR INJECTION VENT WELL (ES, 1994)
VMP1	▲	VAPOR MONITORING POINT (ES, 1994)
CH-5	⊙	SOIL VAPOR EXTRACTION WELL
DMW-1	⊕	GROUNDWATER MONITORING WELL
982540	■	SOIL SAMPLE LOCATION (CBD/DOLVER ENVIRONMENTAL, 1998)
	B	BIOVENTING BLOWER LOCATION
	-×-×-	FENCE

FIGURE 2.4

1998 CONCRETE PAD EXCAVATION SOIL SAMPLING LOCATIONS

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

S:\ES\cad\AFCEE\726876\McClellan\98dn1170.dwg, 12/09/98 at 07:22

TABLE 2.4
1998 EXCAVATION SOIL SAMPLE RESULTS
DAVIS GLOBAL COMMUNICATIONS SITE
McCLELLAN AFB, CALIFORNIA

			Sample Location (Depth in Feet Below Ground Surface)						
			982536/D-36	982537/D-37	982540	982545	982547	982549	982551
Analyte[a/]	Method	Units[b/]	(10)	(10)	(22)	(22)	(22)	(22)	(22)
TPH-d	SW8015m	mg/kg	3,700	1,200	7.7	67	<1.0[c/]	1.8	6.2
TPH-g	SW8015m	mg/kg	<100	<100	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene	SW8020/SW8240	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	na[d/]
Toluene	SW8020/SW8240	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	na
Ethylbenzene	SW8020/SW8240	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	na
Xylenes	SW8020/SW8240	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	na
MTBE	SW8020	mg/kg	---[e/]	---	<0.005	<0.005	<0.005	<0.005	na
Fluorene	SW8270[f/]	mg/kg	0.51	<0.33	---	---	---	---	---
Isophorone	SW8270[f/]	mg/kg	1.1	0.33	---	---	---	---	---
Phenanthrene	SW8270[f/]	mg/kg	4.8	<0.33	---	---	---	---	---
Acetone	SW8240[f/]	mg/kg	0.039	0.032	---	---	---	---	---
Methylene Chloride	SW8240/SW8260[f/]	mg/kg	0.0057	0.0053	0.0060B[g/]	0.0053B	0.0052B	0.0060B	<0.0050

Note: Soil samples were split and sent to two separate labs for analysis. Where duplicate analytical results exist, the greatest detected concentrations are shown.

[a/] TPH-d = total petroleum hydrocarbons as diesel; TPH-g = total petroleum hydrocarbons as gasoline; and MTBE = methyl-tert-butyl-ether.

[b/] mg/kg = milligrams per kilogram.

[c/] < and gray shading indicate compound analyzed for but not detected. Number shown represents the laboratory reporting limit.

[d/] na = results not available.

[e/] --- = not analyzed.

[f/] For these methods, results are shown only for those analytes that were detected in at least one soil sample.

[g/] B = analyte also detected in the method blank.

Based on Option 1 results and excavation soil sampling results, these excavated soils represented the soil interval with the most significant petroleum hydrocarbon contamination. In the area of the excavation, the remaining, lesser-contaminated soils, deeper than 22 feet bgs, are effectively being treated by the existing bioventing system and SVE at CH-5. Air injection/extraction activities continue to enhance aerobic biodegradation of petroleum contaminants in these deeper soils and smear-zone soils. Soil vapor extraction and groundwater extraction are planned to continue at the Davis Site. Recent groundwater monitoring results downgradient of the site indicate that the contaminated soils are not impacting groundwater above the MCLs for BTEX compounds.

While little TPH-d contamination was evident in soils beneath the former concrete pad (Table 2.4); visual evidence of contamination in the excavation sidewalls and associated minor excavations indicates that some petroleum hydrocarbon contamination is still present in shallow, low permeability soils south and east of the concrete pad excavation. The areal extent of shallow contamination in these areas is not known; and, it is presumed that current air injection bioventing and SVE activities will have little impact on these soils.

Based on these findings, AFCEE and McClellan AFB have requested that Option 2 funds originally intended for closure soil sampling be used to investigate the remaining extent of shallow soil contamination and to perform a shallow soil bioventing treatability test. Further details regarding the shallow soils investigation/treatability testing are provided in Section 3.

SECTION 3

SITE SPECIFIC ACTIVITIES

The purpose of this section is to describe the soil investigation and treatability testing activities proposed for the Davis Site. Two confirmation soil borings are proposed for installation adjacent to VW1 and VMP1 to evaluate petroleum hydrocarbon concentrations in soil following more than 5 years of bioventing treatment. In an attempt to further delineate the extent of petroleum hydrocarbon contamination remaining in shallow soils south and east of the excavation, four soil borings advanced to approximately 25 feet bgs are proposed. In addition, a shallow soils bioventing treatability test will be performed. Results of the soil investigation and treatability test will be used to determine if further site remediation is necessary and whether shallow soils bioventing is an effective remedial alternative.

Activities that will be performed include siting and advancement of 8 soil borings and collection of up to 16 soil samples. In addition, treatability testing procedures including soil vapor sampling procedures, air permeability testing procedures, and the blower configuration for introducing air (oxygen) into shallow, low permeability soils are discussed.

3.1 BIOVENTING BLOWER AND SVE WELL SHUTDOWN

It should be noted that approximately 1 month prior to initiating field activities, air injection and extraction activities at the site need to be stopped. Based on the proposed schedule in Section 5 of this work plan, the bioventing blower system and air extraction at CH-5 should be shut down in mid-December 1998. Air injection/extraction activities need to be stopped in preparation for the proposed bioventing treatability test

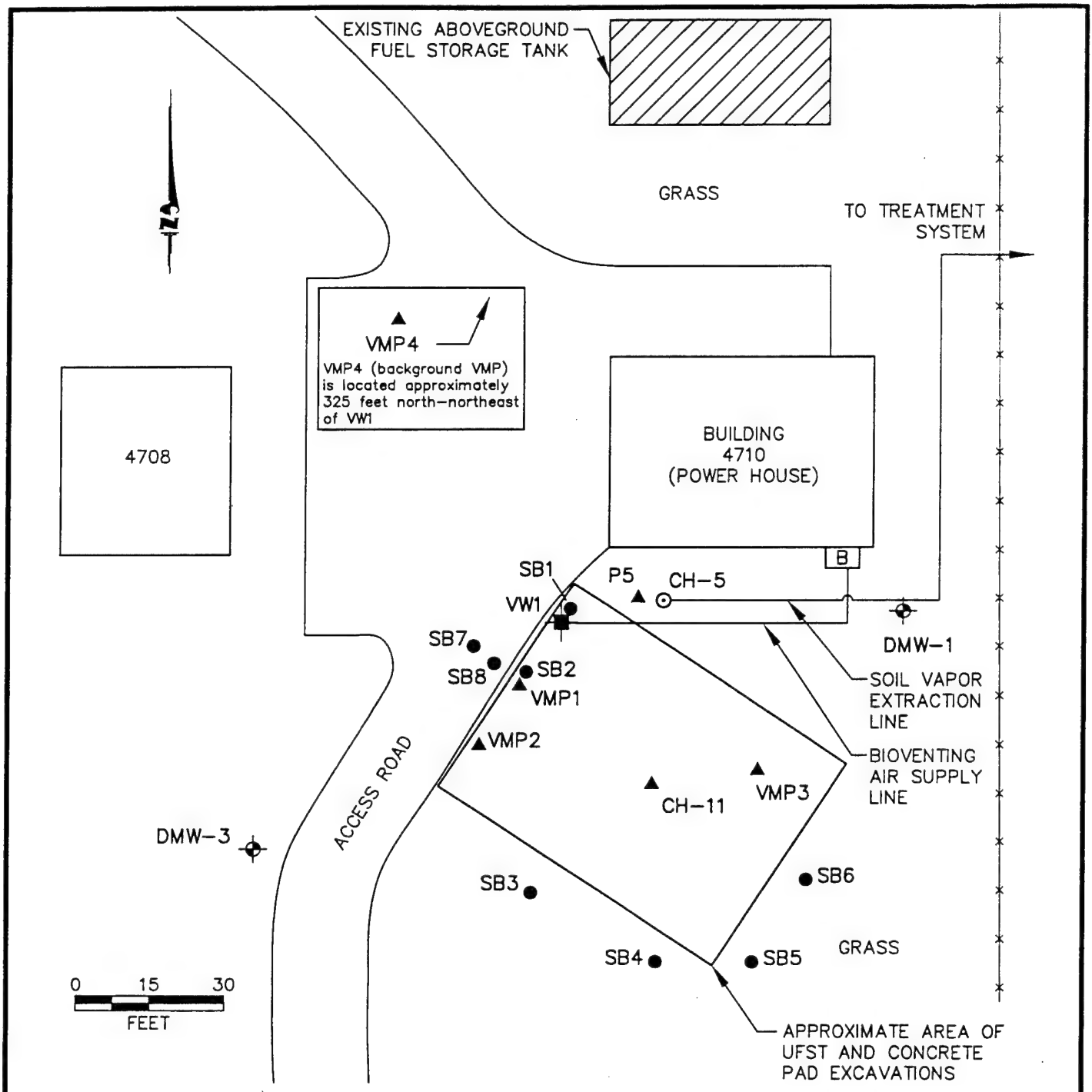
so that anaerobic conditions are allowed to develop in site soil and soil vapor. After testing is completed, air injection/extraction activities at the site can be resumed.

3.2 SOIL SAMPLING

Proposed soil boring locations for confirmation soil sampling, investigation of shallow soils contamination, and placement of bioventing treatability testing components are shown on Figure 3.1. Two confirmation soil borings, SB1 and SB2, will be located adjacent to VW1 and VMP1, respectively. Soil samples will be collected from these borings in order to compare petroleum hydrocarbon concentrations with initial and 1-year soil sampling results (Table 2.1). Locations for soil borings SB3 through SB6 are based on information provided by McClellan AFB (Soper, 1998) that petroleum hydrocarbon contaminated soils were visible south and east of the concrete pad excavation during September 1998 removal activities (Section 2.3.4). Soil borings SB7 and SB8 will be installed on the northwest side of the excavation and completed as a treatability testing vent well (VW2) and vapor monitoring point (VMP5), respectively. A site layout for the proposed bioventing treatability test is shown on Figure 3.2.

Boreholes SB1 through SB6 and SB8 will be advanced using a hollow-stem auger (HSA) drill rig equipped with an 8-inch outside-diameter (OD) auger. Borehole SB7 will be advanced using a 10-inch OD auger for completion as VW2. At SB1 and SB2, soil samples will be collected at 32.5 feet bgs and 15 feet bgs, respectively. At SB3 through SB6, samples will be collected continuously between 5 and 25 feet bgs. Soil samples will be collected in a 2-inch inside-diameter (ID) split-barrel sampler. The split barrel sampler will be fitted with three pre-cleaned, 2-inch OD by 6-inch long, thin-walled, stainless steel or brass sleeves.

Up to 16 soil samples will be submitted for laboratory analysis. Sampling procedures will follow those outlined in the protocol document (Hinchee *et al.*, 1992). A portion of soil from each split spoon will be used for soil headspace screening. Each headspace screening sample will be placed in a sealed plastic bag and allowed to sit in



LEGEND

VW1	■	AIR INJECTION VENT WELL (ES, 1994)
VMP1	▲	VAPOR MONITORING POINT (ES, 1994)
CH-5	⊙	SOIL VAPOR EXTRACTION WELL
DMW-1	⊕	GROUNDWATER MONITORING WELL
SB1	●	PROPOSED SOIL BORING
	B	BIOVENTING BLOWER LOCATION
	×—×	FENCE

FIGURE 3.1

PROPOSED SOIL BORING LOCATIONS

Davis Global Communications Site
McClellan AFB, California

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Denver, Colorado

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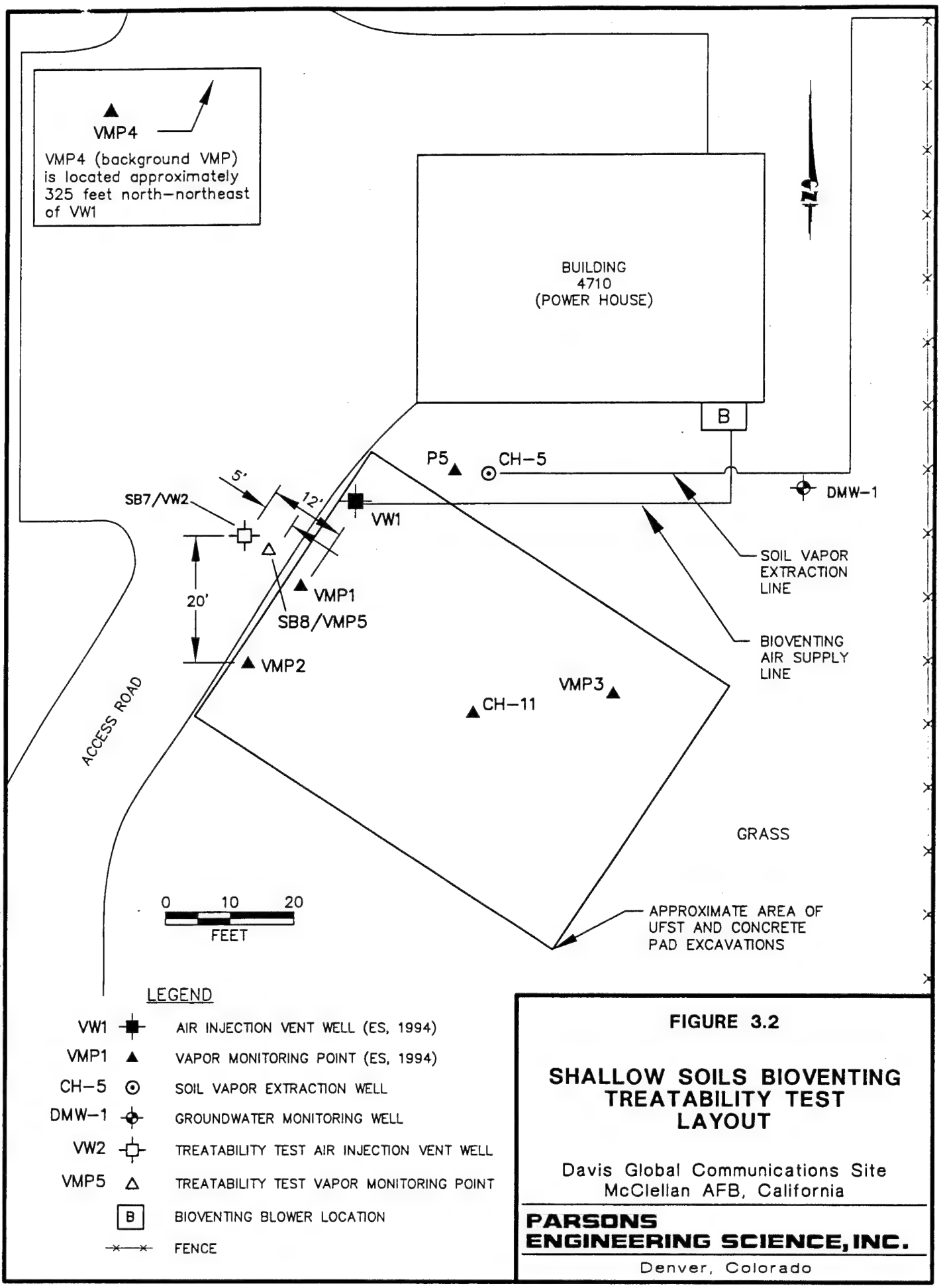

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FIGURE 3.2

SHALLOW SOILS BIOVENTING TREATABILITY TEST LAYOUT

Davis Global Communications Site
McClellan AFB, California

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Denver, Colorado

the shade for at least 5 minutes. Soil headspace will then be screened using a total volatile hydrocarbon analyzer (TVHA) and a photoionization detector (PID). The soil headspace reading will be used in combination with physical and visual evidence of contamination (e.g. odors, staining) to select samples for laboratory analysis.

Based on field screening results, samples from the most contaminated intervals will be analyzed for BTEX, total TPH-d, and soil moisture, using USEPA Methods SW8020 and SW8015-modified, and American Society for Testing and Materials (ASTM) Method D2216, respectively. All samples with detectable concentrations of total TPH-d also will be analyzed for soluble TPH using deionized water extraction (California Title 22, DI-WET Method).

Samples will be collected using a split-spoon sampler containing stainless steel or brass tube liners. Soil samples collected in the liners will be immediately trimmed, and the ends will be sealed with Teflon® fabric held in place by plastic caps. Soil samples will be labeled following the nomenclature specified in the protocol document (Hinchee *et al.*, 1992), wrapped in plastic, placed in a cooler, and maintained at a temperature of approximately 4 degrees centigrade for shipment. A chain-of-custody form will be completed, and the cooler will be shipped to Specialized Assays, Inc. (SAI), in Nashville, Tennessee, for analysis.

3.3 BIOVENTING TREATABILITY TESTING

The bioventing treatability test will be used to determine if air injection bioventing, exclusively within the low permeability soils between 10 and 25 feet bgs, is an effective remediation technique. The existing bioventing system at the Davis Site is effectively treating soils deeper than 25 feet bgs; however, this system has not been effective in treating more shallow soils. Preferential air flow to the deeper, more permeable soils resulting in less oxygen delivery and little enhancement of aerobic fuel biodegradation in the shallow soil zone is a principal reason why the existing bioventing system has been ineffective in treating shallow soils.

The locations and construction details for the treatability test vent well (VW2) and vapor monitoring point (VMP5) and the blower configuration that will be used to inject air (oxygen) into shallow contaminated soils is discussed in this section. In addition, a brief description of the treatability test procedures is provided. Results of the treatability test will be provided in a soil investigation/treatability testing results report.

3.3.1 Layout of Treatability Test Components

A general description of criteria for siting of VWs and VMPs are included in the protocol document (Hinchee *et al.*, 1992). Figure 3.2 illustrates the site layout for the bioventing treatability test. Because of the low permeability soils present between 10 and 25 feet bgs, and the experience Parsons ES has had at similar sites, the potential radial influence of venting around VW2 is expected to be as little as 5 to 20 feet. Therefore, VW2 will be sited approximately 12 feet from VMP1 and 20 feet from VMP2. The shallow screened intervals at VMP1 and VMP2 will be used during the air permeability test. As shown on Figure 3.2, VMP5 will be sited approximately 5 feet from VW2.

3.3.2 Treatability Test Vent Well Installation

VW2 will be constructed of 4-inch-diameter Schedule 40 polyvinyl chloride (PVC), with an estimated 10- to 15-foot interval of 0.04-inch slotted screen set between approximately 10 and 25 feet bgs. The VW2 screened interval will not extend below the silty clay soils which extend to approximately 25 feet bgs (Figure 2.3). Flush-threaded PVC casing and screen with no organic solvents or glues will be used. The filter pack will be a clean Lone Star sand with a #8/16 or #3 grain size and will be placed in the annular space of the screened interval. A 3-foot layer of bentonite will be placed directly over the filter pack. The remaining annular space will then be filled with a bentonite/cement grout to within 18 inches of the ground surface. A complete seal is critical to prevent injected air from short-circuiting to the surface during the bioventing treatability test. Figure 3.3 illustrates the proposed VW construction detail.

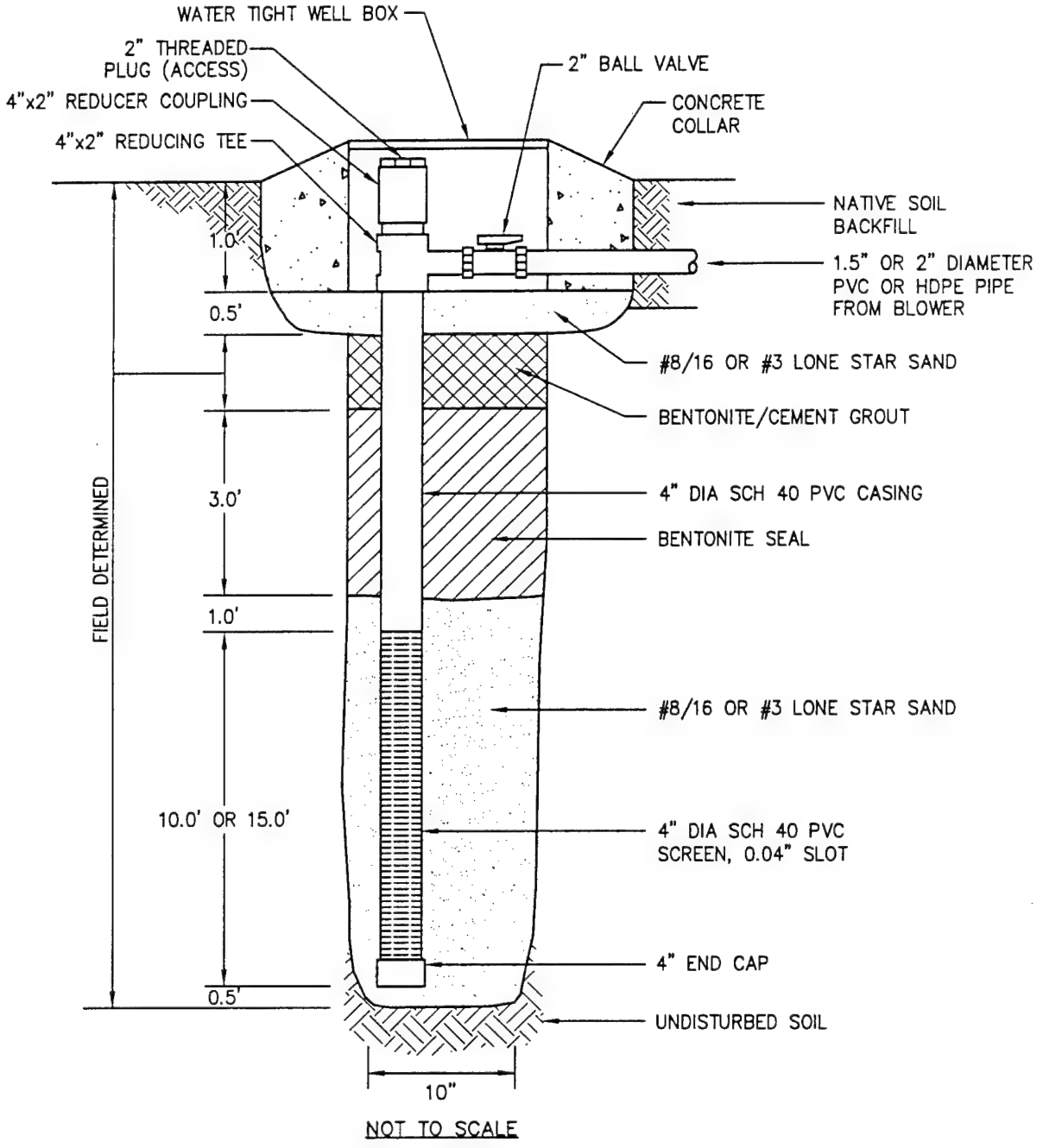

FIGURE 3.3

PROPOSED INJECTION VENT WELL CONSTRUCTION DETAIL

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McClellan AFB, California

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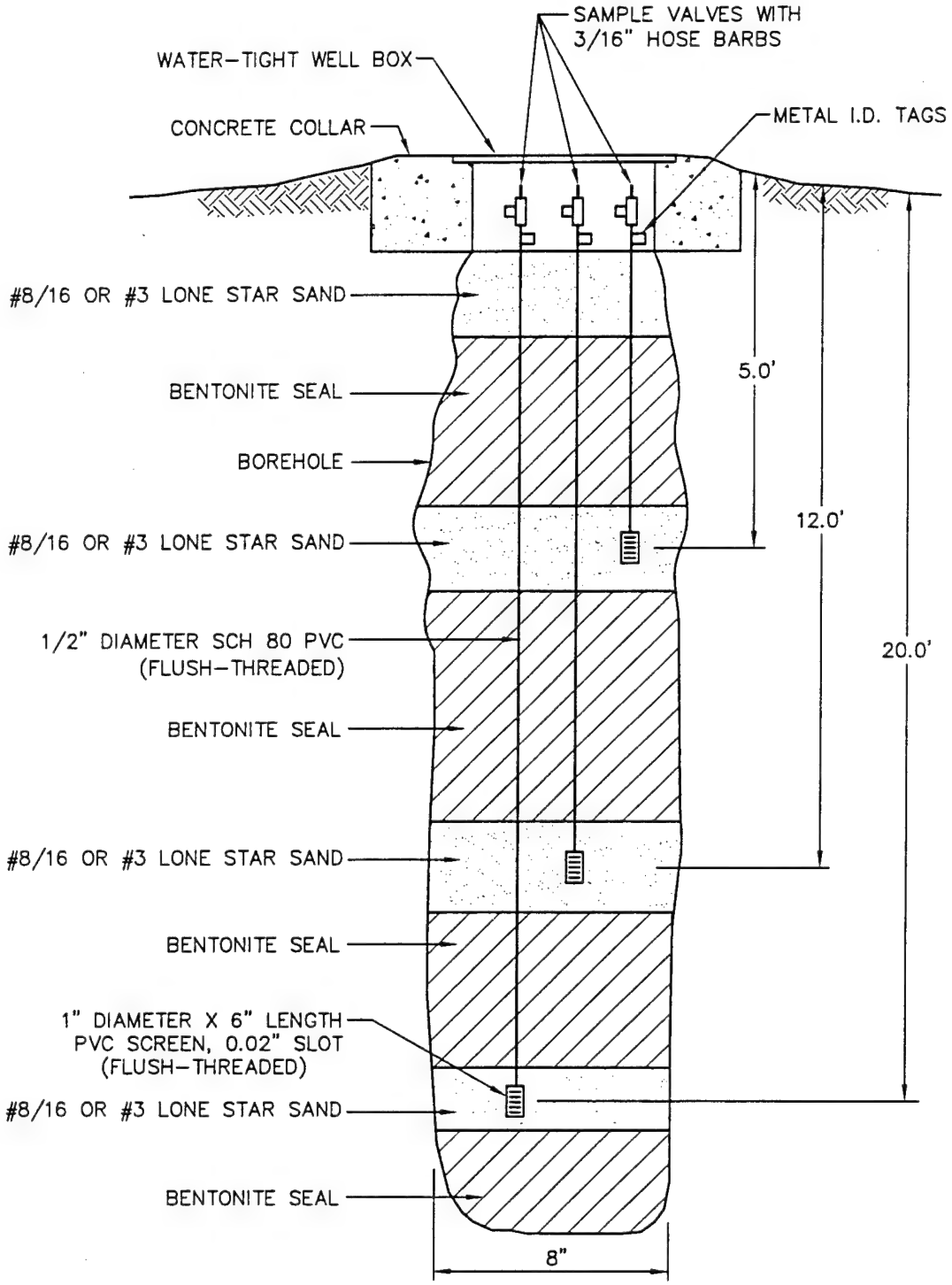
3.3.3 Treatability Test Monitoring Point Installation

Figure 3.4 illustrates the proposed VMP construction detail. VMP5 will be constructed with three vapor probes, each placed within a sand pack and separated from the others by bentonite seals. Vapor probes, constructed of 6-inch-long sections of 1-inch-diameter PVC well screen (0.020-inch slot size), will be placed within a 2-foot layer of clean Lone Star sand with a #8/16 or #3 grain size. The probes will be placed at approximately 5, 12, and 20 feet bgs and connected to the surface with 0.50-inch Schedule 80 PVC risers. The annular spaces between the three screened VMP intervals will be sealed with bentonite to isolate the monitoring intervals. Additional details on VW and VMP construction are presented in Section 4 of the protocol document (Hinchee *et al.*, 1992). No thermocouples will be installed at VMP5, because a thermocouple already exists in shallow soils at VMP1-15.

3.3.4 Treatability Test Soil Vapor Sampling

During bioventing treatability testing, soil vapor samples will be collected from VW2, VMP1, VMP2, and VMP5 for field analyses. Soil vapor from VW2 and the VMP screened intervals will be analyzed using direct-reading field instruments for oxygen, carbon dioxide, and TVH. These samples will be used to establish baseline conditions in the shallow, petroleum-contaminated soils, prior to initiating air permeability testing.

It should be noted that soil vapor purging and sample collection from the shallow VMP depths (between 10 and 25 feet bgs) has been problematic during previous soil vapor sampling events. Soil vapor sample collection has been difficult because of very tight and moist conditions in the shallow soils. Soil vapor sampling procedures for low permeability soils as outlined in the bioventing protocol addendum (Downey and Hall, 1994) have been consistently followed during previous sampling events and will be used for purging and collection of soil vapor samples during treatability testing. Inability to collect soil vapor samples at VMP screened intervals located in the shallow,



NOT TO SCALE

FIGURE 3.4

PROPOSED VAPOR MONITORING POINT CONSTRUCTION DETAIL

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low permeability soils may prevent conclusive decision-making regarding the effectiveness of shallow soils bioventing at the Davis Site.

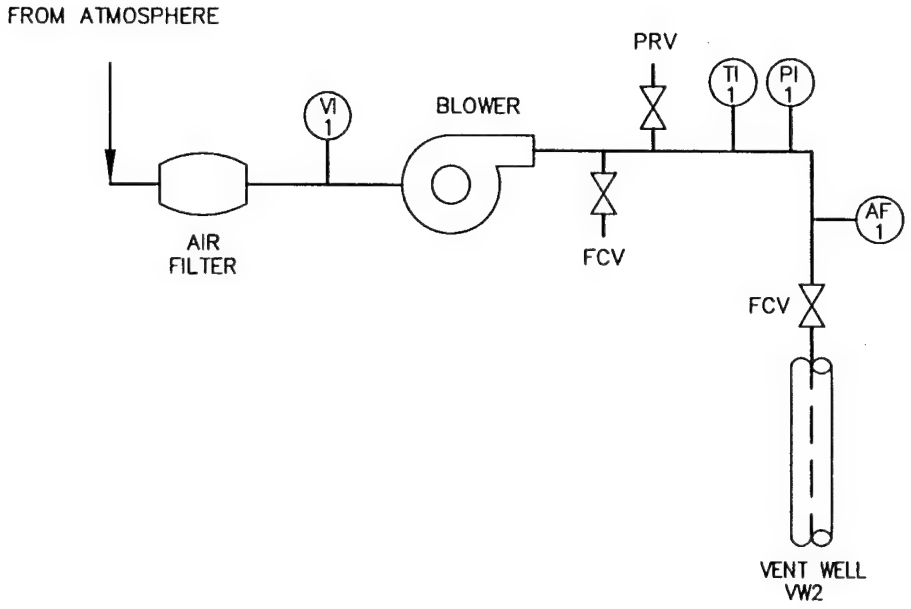
3.3.5 Treatability Test Blower System

A 3.0-horsepower positive displacement blower capable of injecting air at 40 cfm over a wide range of pressures will be used to conduct the bioventing treatability test. Figure 3.5 is a schematic of a typical air injection system used for bioventing treatability testing. The maximum power requirement anticipated for the treatability test is 230-volt, single-phase, 30-amp service. Electrical power will be obtained from the existing power line located on the southeast side of Building 4710 (Figure 2.2). If necessary, installation of additional electrical equipment and necessary wiring will be provided by an electrical subcontractor to be hired by Parsons ES, or by Base personnel.

3.3.6 Air Permeability Test

The objective of the air permeability test is to determine the extent of the subsurface that can be oxygenated by air injection exclusively into shallow soils at the Davis Site. Results from this test will be used in combination with other treatability test results to determine if air injection bioventing is an effective remediation alternative. If the extent of shallow soil contamination remaining at the site is significant and shallow soils bioventing is effective, the results of the air permeability test will be used to recommend well spacing for additional VWs and VMPs. In addition, air permeability testing results will be used to determine recommended air injection rates and injection pressure.

Prior to initiating the test, baseline concentrations of oxygen, carbon dioxide, and TVH will be measured in soil vapor from VW2, VMP1, VMP2, and VMP5. Air will be injected into VW2 using the blower unit, and pressure response will be measured at the treatability test VMPs with differential pressure gauges to determine the region influenced by the unit. The permeability test will be performed at various flow rates to



VW2 WILL BE USED FOR PILOT TEST AIR INJECTION INTO SHALLOW SOILS.

LEGEND

AF 1	AIR FLOW INDICATOR PORT
VI 1	VACUUM INDICATOR
PI 1	PRESSURE INDICATOR
TI 1	TEMPERATURE INDICATOR
TVC	FLOW CONTROL VALVE
PRV	PRESSURE RELIEF VALVE

FIGURE 3.5

PROPOSED BLOWER SYSTEM INSTRUMENTATION DIAGRAM FOR AIR INJECTION

Davis Global Communications Site
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

determine the optimum rate for system operation. Oxygen also will be monitored in the VMPs to ascertain whether oxygen levels in the soil increase as the result of air injection. Based on problems encountered during initial air permeability testing at the Davis Site (Section 2.3.1.1), two air permeability tests may be necessary. It may be necessary to perform air permeability testing for approximately 1 week in order to evaluate pressure and oxygen influence.

3.4 QUALITY ASSURANCE/QUALITY CONTROL

To achieve all quality assurance/quality control (QA/QC) objectives, all site-specific activities will follow the standard operating procedures (SOPs) described in the Basewide Remedial Investigation/Feasibility Study (RI/FS) Quality Assurance Plan (QAP) for McClellan AFB (1994) unless specific exceptions or variations to the SOPs are noted. Additional QA/QC objectives specific to bioventing operations are detailed in the Program Quality Assurance Project Plan for AFCEE Bioventing Pilot Tests (ES, 1993).

3.5 HANDLING OF INVESTIGATION DERIVED WASTE AND DECONTAMINATION PROCEDURES

Drill cuttings and decontamination fluids will be containerized on site in labeled US Department of Transportation-approved 55-gallon drums. Transportation, characterization, and disposal of investigation-derived waste will be performed by Base personnel. Equipment decontamination procedures will follow the QAP SOPs, with the exception that isopropanol may be substituted for methanol during decontamination of downhole equipment.

3.6 REPORTING

A shallow soils investigation/treatability testing results report will be prepared following completion of field activities and receipt of sample results. This report will summarize soil sampling results from the confirmation soil borings, shallow soils investigative borings, and the bioventing treatability test borings. The report also will

summarize well construction activities, soil vapor sampling results, and air permeability test results for the bioventing treatability test.

If the results of the soil investigation and treatability testing indicate that remedial action is necessary and shallow soils bioventing is effective, recommendations for extended/expanded shallow soils bioventing will be included in the results report. However, an expanded bioventing system will not be installed as part of the AFCEE Extended Bioventing Project, because of time and budget constraints.

SECTION 4

BASE SUPPORT REQUIREMENTS

The following Base support is needed prior to the arrival of the drilling subcontractor and the Parsons ES field team:

- Shut off the existing bioventing blower system and discontinue vapor extraction at CH-5 in mid-December 1998 until field activities are completed;
- Obtain all necessary regulatory concurrence for well installation, sampling, and treatability testing;
- Obtain any required digging permits and/or permits needed to install wells within shallow soils down to approximately 25 feet bgs;
- Coordinate Base electrical support or obtain any needed permission to allow Parsons ES subcontractors to perform electrical hookup of the blower;
- Provide any paperwork required to obtain gate passes and security badges for approximately two Parsons ES employees and two employees for the drilling subcontractor. Vehicle passes will be needed for two trucks and a drill rig. The passes must be valid for the expected duration of drilling operations and treatability testing (approximately 3 weeks).

SECTION 5

PROJECT SCHEDULE

Because 31 March 1999 represents the last day of performance under the AFCEE Extended Bioventing Project (Contract F41624-92-8036, Order 17), an accelerated project schedule, including accelerated work plan review by AFCEE, McClellan AFB, and regulatory agencies, is necessary. The following schedule is contingent upon timely review and approval of the work plan and completion of McClellan AFB support requirements.

Event	Completion Date
Shut down bioventing blower system and air extraction activities at CH-5	14 December 1998
Draft work plan delivered to McClellan AFB, AFCEE, and regulatory agencies	10 December 1998
All comments on draft work plan received by Parsons ES from McClellan AFB, AFCEE, and regulatory agencies	8 January 1999
Digging permit and personnel/vehicle passes due from McClellan AFB	11 January 1999
Final work plan delivered to McClellan AFB, AFCEE, and regulatory agencies	13 January 1999
Commencement of field activities	13 January 1999
Completion of field activities	29 January 1999
Results report delivered to McClellan AFB and AFCEE	12 March 1999

SECTION 6

POINTS OF CONTACT

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SECTION 7

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APPENDIX B
SOIL BORING LOGS

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB1

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility 2.5ft. NNE of VW-1	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/14/99	**TOTAL DEPTH:** approx. 34 feet bgs

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	BREATHING ZONE (ppm)	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0					0.0		Logged cuttings only- one sample collected with 18" split spoon at 32ft.
5						CL	Cuttings - CLAY: very dark grayish brown (2.5Y3/2), damp, slight-medium plasticity.
10					0.0		Color change to 2.5Y4/2.
15							(Cuttings = 4.2ppm)
							Silty CLAY: olive brown (2.5Y4/3-4/4), stiff, damp, slightly plastic
20					0.0		(Cuttings = 2.4ppm)
25							(Cuttings = 0.0ppm)
					0.0		
30		SB-1-A 32.5-33ft. (10:40) 1/14/99	0.0/0	■		SP	SAND: loose, dark gray, fine grained, well sorted, saturated. subround-subangular, 20-30% mafics.
35							
40							
45							

– – - Contact approximately located. PID - Photoionization detector reading. ■ - Indicates sample submitted to laboratory for analysis

▽ - First encountered groundwater level. TVH - Total Volatile Hydrocarbon meter reading.

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB2

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility 2'3" N of VMP-1	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/14/99	**TOTAL DEPTH:** approx. 15 feet bgs

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	BREATHING ZONE (ppm)	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0							Logged cuttings only- one sample collected with 18" split spoon at 15ft.
5					0.0	CL	Cuttings - silty CLAY: very dark brown (10YR2/2), damp, medium plasticity, minor coarse sand.
10					0.0-2.3		Clay becomes black, hydrocarbon odor, medium plastic, stained.
15		SB2-A 15-15.5ft. SB9-A 15.5-16ft. (DUPof SB2-A)	25.6/20	■			Strong hydrocarbon odor. CLAY: very stiff-hard, very dark (stained), cuttings=25.3ppm.
20							
25							
30							
35							
40							
45							

– – - Contact approximately located. PID - Photoionization detector reading. ■ - Indicates sample submitted to laboratory for analysis

▽ - First encountered groundwater level. TVH - Total Volatile Hydrocarbon meter reading.

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB3

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility 30' south of VMP-1	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/20/99	**TOTAL DEPTH:** approx. 24 feet bgs

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	BREATHING ZONE (ppm)	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0						CL	Hand augered to 4' bgs. Silty clay, dark brown, damp, plastic, becomes light brown at 4'.
5			0.0/2		0.0	ML	Clayey SILT: very dark grayish brown (10Y3/2), very stiff-hard, damp, medium plasticity, very thin white plant roots.
			0.0/8				
		SB3-A 9-9.5ft. (9:06)1/20/99	0.0/22				
10			0.0/10			CL	CLAY: yellowish brown (10YR5/4), medium stiff, plastic, damp.
			0.0/8				
			0.0/0				
15			0.0/0				As above (stiff-very stiff)
			No bag		0.0		
			0.0/0				
20			0.0/0				Becoming silty, hard, dry.
		SB3-B 22.5-23ft. (10:34)1/20/99	0.0/4			ML/CL	Silty CLAY/clayey SILT: hard, minor sand.
			0.0/40			SP	Silty SAND: very fine-fine grained, damp, dense, drk yellow brown (10YR4/4), minor clay.
25							
30							
35							
40							
45							

– – - Contact approximately located. PID - Photoionization detector reading. ■ - Indicates sample submitted to laboratory for analysis

▽ - First encountered groundwater level. TVH - Total Volatile Hydrocarbon meter reading.

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB4

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility 22.5' south and 2' west of CH11	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/20/99	**TOTAL DEPTH:** approx. 23 feet bgs

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	BREATHING ZONE (ppm)	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0						CL	Hand augered to 5' bgs. Silty clay, dark brown-black, damp.
5			0.0/12		0.0	ML	SILT: clayey, dark yellow brown (10YR3/4), damp, medium plasticity, very thin white plant roots.
			0.0/16				
			0.0/28				Clayey SILT: medium plasticity (as above)
10			0.0/30				
			0.0/28				Very dark brown SILT
		SB4-A 13.5-14ft. (12:50)1/20/99	0.0/180			CL	CLAY: dark brown, damp, stiff-med. stiff.
15			0.0/120				CLAY: very dark brown (10YR2/2)(stained), damp, stiff,
			0.0/44				Color change to brown (10YR4/3).
			0.0/16		0.0		
			0.0/16				CLAY: yellowish brown (10YR5/6), stiff, slightly plastic, damp.
20		SB4-B 21-21.5ft. (13:30)1/20/99	0.0/0				
			0.0/4			SC	SAND: very fine-fine grained, well sorted, med. dense, drk yellow brown (10YR4/4), minor clay and silt.
25							
30							
35							
40							
45							

– – - Contact approximately located. PID - Photoionization detector reading. ■ - Indicates sample submitted to laboratory for analysis

▽ - First encountered groundwater level. TVH - Total Volatile Hydrocarbon meter reading.

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB5

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility 25.5ft. S of VMP-3	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/19/99	**TOTAL DEPTH:** approx. 24.5 feet bgs

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	BREATHING ZONE (ppm)	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0							Hand auger to 5' bgs.
							Silty clay, clayey silt: drk brown, damp.
5			0.0/18			ML	Clayey SILT: dry, dark brown (10YR4/3), fine white plant roots, very stiff.
			0.0/20		0.0		
			0.0/16				SILT: dark yellowish brown (10YR4/4), medium stiff, thin white plant roots.
10			8.0/24				
			0.0/16			CL	CLAY: brown (10YR4/3), stiff-very stiff, damp, med plastic.
		SB5-A 13.5-14ft. 1/19/99	0.0/22	■			
15			0.0/12				
			0.0/10				CLAY: dark yellowish brown (10YR4/4), very stiff, damp.
			0.0/2		0.0		
			0.0/6				
20		SB5-B 21-21.5ft. 1/19/99	0.0/6	■			
			0.0/12				Becoming silty, yellowish brown (10YR5/6), stiff, medium plasticity.
			0.0/4			SP	SAND: yellowish brown, fine grained, well sorted, damp, dense, subrounded grains.
25							
30							
35							
40							
45							

– – – Contact approximately located. PID - Photoionization detector reading. ■ - Indicates sample submitted to laboratory for analysis

▽ - First encountered groundwater level. TVH - Total Volatile Hydrocarbon meter reading.

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB6

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility 50' South of DMW-1	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/19/99	**TOTAL DEPTH:** approx. 26 feet bgs

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	BREATHING ZONE (ppm)	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0							Hand augered to 5' bgs.
5			0.0/10			ML	SILT: dark yellowish brown (10YR4/4), dry, hard, very thin plant roots.
			0.0/6				(Same as above)clayey, stiff.
10			0.0/4		0.0		SILT: yellowish brown (10YR5/4), clayey, plastic.
		SB6-A 12.5-13ft. (10:10)1/19/99	0.0/2	■		CL	CLAY: dark yellowish brown (10YR3/4),damp, plastic, stiff.
15			0.0/2				
			0.0/2				
			0.0/0		0.0		CLAY: brown (10YR4/3),damp, plastic, stiff.
20			0.0/4				
			0.0/4				becomes yellowish brown (10YR5/6).
			0.0/4				becomes silty w/minor fine sand.
		SB6-B 23-23.5ft. (11:15)1/19/99	0.0/18	■			
25			0.0/12			SC	SAND: 10YR4/6, very fine grained, damp, dense, well sorted, micaceous, clayey.
			0.0/28				
30							
35							
40							
45							

– – – Contact approximately located. PID - Photoionization detector reading. ■ - Indicates sample submitted to laboratory for analysis

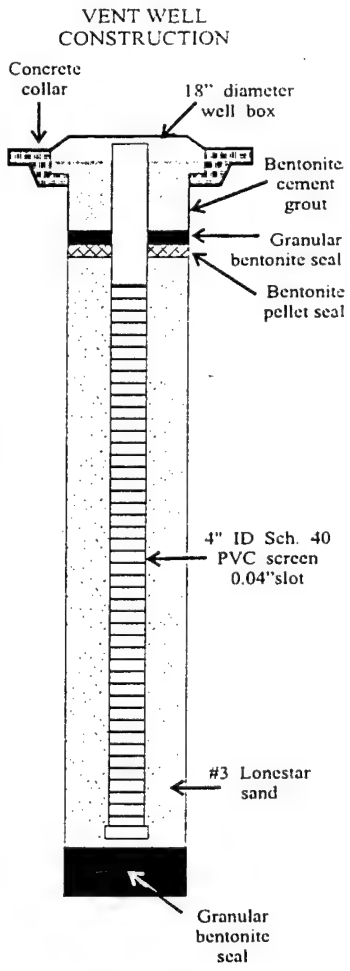
▽ - First encountered groundwater level. TVH - Total Volatile Hydrocarbon meter reading.

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB7/VW2

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Global Communications Facility SB7 is 12ft. NW of VMP-1.	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 10 inches
COMPLETION DATE: 1/15/99	**TOTAL DEPTH:** 27.5 feet below ground surface

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	GEOLOGIC LOG	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0							2-3" asphalt, fill beneath is silty sandy gravel, brown.
						CL	CLAY: silty, black (10YR2/1), slightly plastic, stiff, damp.
5			0.0/0				CLAY: as above but dark grayish brown.
			0.0/0				CLAY: dark yellowish brown (10YR4/4), very stiff, dry-damp, silty.
			0.0/0			ML	Clayey SILT: dark yellowish brown, dry.
10			0.0/0			CL	CLAY: dark grayish brown (10YR4/2), plastic.
			0.0/0				
			0.0/0				Stiff clay, brown (10YR5/3), medium plastic.
15			0.0/2				
		SB7-A 18-18.5ft. (10:00) 1/15/99	0.0/4				(as above) damp, very stiff.
20			0.0/8				
			0.0/0				
		SB7-B 24-24.5ft.. (10:42) 1/15/99	0.0/10				silty CLAY: dark grayish brown (10YR4/4), damp, stiff.
25			0.0/0				
			0.0/0			SP/SM	SAND: dark yellowish brown (10YR4/6), silty, damp-moist, fine grained, well sorted.
30							
35							
40							



- - - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

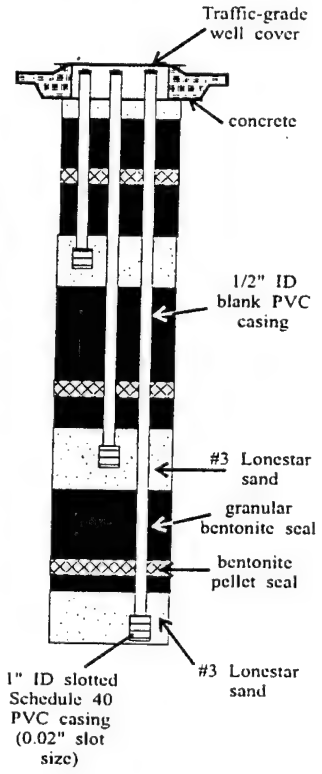
▬ - Sample submitted for laboratory analysis.

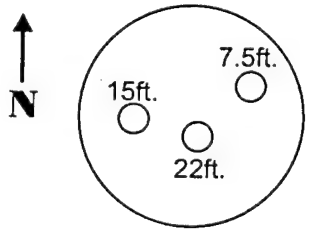
BORING NUMBER: SB8/VMP5

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility SB8/VMP-5 is 7' northwest of VMP-1	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/18/99	**TOTAL DEPTH:** 27 feet below ground surface

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	BREATHING ZONE (ppm)	SAMPLE	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0							3" asphalt, silty sandy gravel fill beneath asphalt.
5			0.0/0	0.0		CH	CLAY: black, plastic, moist, stiff (2.5Y2.5/1)
			0.0/0			ML	clayey SILT: very stiff, damp, olive brown (2.5Y4/3), medium plasticity, minor very fine sand lenses.
			0.0/6				
10			0.0/6	0.0		CH	CLAY: olive brown (2.5Y4/4), plastic, damp, medium stiff.
			0.0/6				
		SB8-A, 13-13.5ft. (10:12) 1/18/99	0.0/0				Same as above.
15			0.0/2				CLAY: olive brown (2.5Y4/4), very stiff, plastic, moist.
			0.0/2				
			0.0/2				becomes light olive brown (2.5Y5/6), very stiff.
20			0.0/0				
			0.0/4	0.0			
			0.0/10				Becoming silty, olive brown, damp, stiff-very stiff.
		SB8-B, 24-24.5ft. (11:15) 1/18/99	0.0/24				
25			0.0/2			SM	Silty SAND: very fine grained, stiff, moist.
			0.0/4				
							Boring backfilled to 22 ft.
30							
35							
40							

VAPOR MONITORING POINT WELL CONSTRUCTION





Plan View

- - - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

▬ - Sample submitted for laboratory analysis.

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB11

PROJECT NUMBER: 726876.36120	**PROJECT NAME:** McClellan Air Force Base Bioventing Davis Global Communications Facility
CLIENT: AFCEE	
LOCATION: Davis Communications Facility 18.5' southeast of VMP-3	**DRILLING METHOD:** Hollow Stem Auger (A400)
GEOLOGIST: Amanda Freeman Bielskis	**HOLE DIAMETER:** 8 inches
COMPLETION DATE: 1/21/99	**TOTAL DEPTH:** approx. 24 feet bgs

DEPTH (feet)	GW DEPTH	SAMPLE NUMBER	HEADSPACE PID/TVH (ppmv)	SAMPLE	BREATHING ZONE (ppm)	USCS CLASSIFICATION	GEOLOGIC DESCRIPTION
0							Hand augered to 5' bgs. Silty clay, dark brown - black, damp
					0.0		
5			0.0/28			ML	Clayey SILT: yellowish brown (10YR5/6), stiff, dry, very thin white plant roots.
			0.0/64				
		SB12-A 11.5-12ft. (12:00)(DUP of SB11A)	0.0/72				Becomes dark yellowish brown (10YR4/4), increasing clay content, plastic, stiff, slightly damp.
10			0.0/82				
		SB11-A 12-12.5ft. (10:10)1/21/99	0.0/120	■		CL	CLAY: brown (10YR4/3), silty, plastic, damp, medium stiff.
			--/58				
15			--/30				Becomes very stiff, dark brown (10YR3/3).
			--/34				
			--/32				
			--/30		0.0		Becoming more silty, dry, yellowish brown (10YR5/6).
20		SB11-B 21-21.5ft. (10:53)1/21/99	--/24				
			--/20			ML/CL	Silty CLAY/clayey SILT: yellow brown, stiff- very stiff, slightly damp.
						SC	SAND: clayey, very fine grained, slightly damp, medium dense.
25							
30							
35							
40							
45							

- - - Contact approximately located. PID - Photoionization detector reading. ■ - Indicates sample submitted to laboratory for analysis

▽ - First encountered groundwater level. TVH - Total Volatile Hydrocarbon meter reading.

APPENDIX C
LABORATORY ANALYTICAL RESULTS

SPECIALIZED ASSAYS INC. • 2960 Foster Creighton Dr. • P.O. Box 40566 • Nashville, Tennessee 37204-0566
615-726-0177 • 1-800-765-0980 • Fax 615-726-3404

CASE NARRATIVE

Client: Parsons Engineering Science (8185)
Attn: John Ratz
1700 Broadway, Suite 900
Denver, CO 80290

Client Project: McCLELLAN afb, Site Davis — Matrix: Soil

Laboratory Project: 128342 — Number samples: 10

Date Received: 01/22/99 — Date Collected: 1/18/99 – 01/20/99

Sample Receipt Notes: All samples were received in good condition, properly preserved. There were no discrepancies noted on the cooler receipt form
QA/QC Summary:

Extractable TPH – 8015B/3550 – Batch 6912

All surrogate and QC parameters are within acceptable limits. Sample SB-8A was used for the batch MS/MSD analysis. There are no QC anomalies noted in the data package.

BTEX – 8021B – Batch3971

The sample used for MS/MSD analysis was not part of this sample delivery group. All recoveries for this analytical batch were within acceptable QC statistical limits.

The enclosed disk contains the IRPIMS deliverables for this sample delivery group. If you have any technical issues relating to the enclosed data, please call me at 1-800-765-0980.

Johnny A. Mitchell
Director of Technical Services

PARSONS ENGINEERING SCIENCE, INC.
21[redacted]ebs[redacted]reet[redacted]e /0[redacted]
Oakland, California 94612
Phone: (510) 891-9085
FAX: (510) 835-4355

CHAIN OF CUSTODY RECORD

Project No.: 726876.36120 Lab Account No.: 8185

Project Name/Location: McClellan AFB; Davis Site

Site Manager: Michael Phelps (Oakland, CA)

Project Manager: John Ratz (Denver, CO)

Samplers: (Initials and Signatures)
AFB
Andrea Bulakis

Lab: Bruce Schlatter/Mary Louise Linn
Specialized Assays, Inc. (SAI)
2960 Foster Creighton Drive
Nashville, TN 37204
(615) 726-0177
Fax:(615) 726-3404

Sample ID	Date	Time	Begin Depth	End Depth	Matrix	NO. OF CONTAINERS	ANALYTES (METHOD) ORGANICS: Extract. TPH/DRO (8015M)	Leachable TPH/DRO (DI-WET/8015M) note 1	BTEX (8020A)	Total Organic Carbon (SW9060)	INORGANICS: Moisture Content (ASTM D-2216)	OTHER	Sample Remarks
SB8A	1/18/99	1012	13	13.5	soil	1	X	X	X		X		8749
SB8-B	1/18/99	1115	24	24.5	soil	1	X	X	X		X		50
SB 6-A	1/19/99	1010	12.5	13	soil	1	X	X	X		X		51
SB 6-B	1/19/99	1115	23	23.5	soil	1	X	X	X		X		52
SB 5-A	1/19/99	1412	13.5	14	soil	1	X	X	X		X		53
SB 5-B	1/19/99	1507	21	21.5	soil	1	X	X	X		X		54
SB 3-A	1/20/99	906	9	9.5	soil	1	X	X	X		X		55
SB 3-B	1/20/99	1034	22.5	23	soil	1	X	X	X		X		56
SB 4-A	1/20/99	1250	13.5	14	soil	1	X	X	X		X		57
SB 4-B	1/20/99	1330	21	21.5	soil	1	X	X	X		X		8758
					soil								
					soil								000001

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
Andrea Bulakis	1/21/99				
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED FOR LAB BY: (SIGNATURE)	DATE	TIME
			M. Brady	1/22/99	9:00

SPECIFIC ANALYTICAL METHOD FOOTNOTES:
1. Deionized water extraction (California Title 22 method); DO LEACHABLE ONLY IF TOTAL TPH IS DETECTED AND AFTER CONSULTATION WITH SITE MANAGER (PHELPS).

GENERAL COMMENTS/INSTRUCTIONS:
1. FAX chain-of-custody on check-in to site manager (Phelps). 4°C
2. QC and reporting limits of contract 726876.3016.00 must be met.
3. Option 2 pricing applies and IRPIMS electronic deliverable IS required.

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

PARSONS ENGINEERING SCIENCE, INC.
2101 Webster Street, Suite 700
Oakland, California 94612
Phone: (510) 891-9085
FAX: (510) 835-4355

CHAIN OF CUSTODY RECORD

Project No.: 726876.36120 Lab Account No.: 8185

Project Name/Location: McClellan AFB; Davis Site

Site Manager: Michael Phelps (Oakland, CA)

Project Manager: John Ratz (Denver, CO)

Samplers: (Initials and Signatures)
AFB A Bielskis
Anda Bielskis

Lab: Bruce Schlatter/Mary Louise Linn
Specialized Assays, Inc. (SAI)
2960 Foster Creighton Drive
Nashville, TN 37204
(615) 726-0177
Fax:(615) 726-3404

Sample ID	Date	Time	Begin Depth	End Depth	Matrix	NO. OF CONTAINERS	ANALYTES (METHOD) ORGANICS: Extract. TPH/DRO (8015M)	Leachable TPH/DRO (DI-WET/8015M) note 1	BTEX (8020A)	Total Organic Carbon (SW9060)	INORGANICS: Moisture Content (ASTM D-2216)	OTHER	Sample Remarks
SB11A	1/21/99	1010	12	12.5	soil	1	X	X	X		X		8759
SB11-B	1/21/99	1053	21	21.5	soil	1	X	X	X		X		1 60
SB12-A	1/21/99	1200	11.5	12	soil	1	X	X	X		X		8761
					soil								
					soil								
					soil								
					soil								
					soil								
					soil								
				-	soil								
					soil								
					soil								000002
					soil								

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
Anda Bielskis	1/21/99				
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED FOR LAB BY: (SIGNATURE)	DATE	TIME
			MB	1/22/99	9:00

SPECIFIC ANALYTICAL METHOD FOOTNOTES:
1. Deionized water extraction (California Title 22 method): DO LEACHABLE ONLY IF TOTAL TPH IS DETECTED AND AFTER CONSULTATION WITH SITE MANAGER (PHELPS).

GENERAL COMMENTS/INSTRUCTIONS:
1. FAX chain-of-custody on check-in to site manager (Phelps).
2. QC and reporting limits of contract 726876.3016.00 must be met.
3. Option 2 pricing applies and IRPIMS electronic deliverable IS required.

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

Cooler Receipt Form

Client: Parsons Engineering Science

Cooler Received On: 11/22/99 And Opened On: 11/22/99 By: Mark Beasley

M. Beasley
(Signature)

1. Temperature of Cooler when opened 4c

2. Were custody seals on outside of cooler and intact? (Yes) No

   a. If yes, what kind and where: Tape 2 Front/Back

   b. Were the signature and date correct? (Yes) No

3. Were custody papers inside cooler? (Yes) No

4. Were custody papers properly filled out (ink, signed, etc)? (Yes) No

5. Did you sign the custody papers in the appropriate place? (Yes) No

6. What kind of packing material was used? Bubblewrap

7. Was sufficient ice used (if appropriate)? (Yes) No

8. Did all bottles arrive in good condition (unbroken)? (Yes) No

9. Were all bottle labels complete (#, date, signed, pres, etc)? (Yes) No

10. Did all bottle labels and tags agree with custody papers? (Yes) No

11. Were correct bottles used for the analysis requested? (Yes) No

12. If present, were VOA vials checked for absence of air bubbles and noted if found? (Yes) No

13. Was sufficient amount of sample sent in each bottle? (Yes) No

14. Were correct preservatives used? (Yes) No

15. Corrective action taken, if necessary:

   a. Name of person contacted: _____

   b. Date _____

000003

VOLATILE ORGANICS SW8021B

SUMMARY DATA

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-8A 13 - 13.5 ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8749
Date Sampled: 1/18/99
Date Received: 1/22/99
Analysis Date: 1/23/99
Analysis Time: 21:52
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.7	
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-8B

24 - 24.5 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8750
Date Sampled: 1/18/99
Date Received: 1/22/99
Analysis Date: 1/23/99
Analysis Time: 22:30
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000006

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-6A

12.5-13

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8751
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/23/99
Analysis Time: 23:08
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000007

COPY 1

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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-6B 23-23.5'

Matrix: Soil
% Dry Weight: 84.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8752
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/23/99
Analysis Time: 23:45
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000008

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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-5A 13.5-14 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8753
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 0:23
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000009

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-5B

21 - 21.5 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8754
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 1:00
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000010

COPY 1

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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-3A 9-9.5 ft

Matrix: Soil
% Dry Weight: 80.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8755
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 1:38
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.5	U
100-41-4	Ethylbenzene	2.5	U
1330-20-7	Xylenes, total	2.5	U

000011

COPY 1

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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-3B

22.5 - 23

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8756
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 3:32
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000012

COPY 1

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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-4A 13.5-14 ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8757
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 4:09
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000013

COPY 1

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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-4B 21-21.5'

Matrix: Soil
% Dry Weight: 84.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8758
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 4:47
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000014

COPY 1

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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-11A

12 - 12.5'

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8759
Date Sampled: 1/21/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 5:24
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000015

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-11B 21-21.5'

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8760
Date Sampled: 1/21/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 6:02
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.3	U
100-41-4	Ethylbenzene	2.3	U
1330-20-7	Xylenes, total	2.3	U

000016

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-12A

11.5-12 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 128342
Instrument:

Lab Sample ID: 99-A8761
Date Sampled: 1/21/99
Date Received: 1/22/99
Analysis Date: 1/24/99
Analysis Time: 6:39
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000017

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

BLANK

Matrix: Soil
% Dry Weight: 100
Units: UG/KG
Dilution Factor: 1
Analysis Method: SW8015
Delivery Group: 128342
Instrument:

Lab Sample ID: BLANK
Date Sampled: 1/18/99
Date Received: 1/22/99
Analysis Date: 1/23/99
Analysis Time: 21:15
Sample QC Group: 3971

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION		FLAG
71-43-2	Benzene	1.	....	U
108-88-3	Toluene	2.	....	U
100-41-4	Ethylbenzene	2.	....	U
1330-20-7	Xylenes, total	2.	....	U

000013

COPY 1

EXTRACTABLE PETROLEUM HYDROCARBONS
SW8015B

SUMMARY DATA

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-8A 13-13.5ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8749
Date Sampled: 1/18/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 20:20
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1370	J

000092

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-8B

24-24.5'f

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8750
Date Sampled: 1/18/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 20:49
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1690	J

000093

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-6A

12.5-13 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8751
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 21:18
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1780	.... J

000094

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-6B

23-23.5'

Matrix: Soil
% Dry Weight: 84.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8752
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 21:47
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1810	.... J

000095

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-5A

13.5 - 14 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8753
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 22:16
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1780	J

000096

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-5B

21-21.5'

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8754
Date Sampled: 1/19/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 22:45
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1980	J

000097

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-3A 9-9.5 ft

Matrix: Soil
% Dry Weight: 80.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8755
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 23:42
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1600	J

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-3B

22.5-23'

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8756
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/26/99
Analysis Time: 0:11
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1360	.... J

000099

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-4A

13.5 - 14 ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8757
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/26/99
Analysis Time: 0:40
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1900	J

000100

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-4B 21 - 21.5ft

Matrix: Soil
% Dry Weight: 84.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8758
Date Sampled: 1/20/99
Date Received: 1/22/99
Analysis Date: 1/26/99
Analysis Time: 1:09
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1330	J

000101

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-11A 12-12.5 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8759
Date Sampled: 1/21/99
Date Received: 1/22/99
Analysis Date: 1/26/99
Analysis Time: 1:38
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1980	.... J

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-11B

21 - 21.5 f

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8760
Date Sampled: 1/21/99
Date Received: 1/22/99
Analysis Date: 1/26/99
Analysis Time: 2:06
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1400	J

000103

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-12A

11.5-12'

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A8761
Date Sampled: 1/21/99
Date Received: 1/22/99
Analysis Date: 1/26/99
Analysis Time: 2:35
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	1690	J

000134

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

BLANK

Matrix: Soil
% Dry Weight: 100
Units: UG/KG
Dilution Factor: 1
Analysis Method: SW8270B
Delivery Group: 128342
Instrument: PE-1
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: BLANK
Date Sampled: 1/18/99
Date Received: 1/22/99
Analysis Date: 1/25/99
Analysis Time: 20:20
Sample QC Group: 6912

Extraction Date: 1/25/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	10000	U

SPECIALIZED ASSAYS INC. • 2960 Foster Creighton Dr. • P.O. Box 40566 • Nashville, Tennessee 37204-0566
615-726-0177 • 1-800-765-0980 • Fax 615-726-3404

CASE NARRATIVE

Client: Parsons Engineering Science (8185)
Attn: John Ratz
1700 Broadway, Suite 900
Denver, CO 80290

Client Project: McClellan AFB, Davis Site

Matrix: Soil

Laboratory Project: 127679

Number samples: 5

Date Received: 01/16/99

Date Collected: 01/14/99 – 01/15/99

Sample Receipt Notes: All samples were received in good condition, properly preserved. There were no discrepancies noted on the cooler receipt form. All analyses were performed within method specified holding times.

QA/QC Summary:

Volatile Organics – 8021B – Batch 1247

All matrix spike, spike duplicate, and laboratory control sample recoveries were within acceptable quality control limits. The sample used for MS/MSD was SB7-B.

Extractable TPH – 8015B – Batch 4811

Recoveries for the matrix spike and matrix spike duplicate are not reported due to the level of contamination in the original sample (SB1-A). Recovery of the spiked mixture for the laboratory control sample were within acceptable limits.

If you have any technical issues relating to the enclosed data, please call me at 1-800-765-0980.

Johnny A. Mitchell
Director of Technical Services

PARSONS ENGINEERING SCIENCE, INC.
2101 Webster Street, Suite 700
Oakland, California 94612
Phone: (510) 891-9085
FAX: (510) 835-4355

CHAIN OF CUSTODY RECORD

Project No.: 726876.36120 Lab Account No.: 8185
Project Name/Location: McClellan AFB; Davis Site
Site Manager: Michael Phelps (Oakland, CA)
Project Manager: John Ratz (Denver, CO)

Samplers: (Initials and Signatures)
AFB
Andrea Bielskis

Lab: Bruce Schlatter/Mary Louise Linn
Specialized Assays, Inc. (SAI)
2960 Foster Creighton Drive
Nashville, TN 37204
(615) 726-0177
Fax:(615) 726-3404

000001

Sample ID	Date	Time	Begin Depth	End Depth	Matrix	NO. OF CONTAINERS	ANALYTES (METHOD) ORGANICS: Extract. TPH/DRO (8015M)	Leachable TPH/DRO (DI-WET/8015M) note 1	BTEX (8020A)	Total Organic Carbon (SW9060)	INORGANICS: Moisture Content (ASTM D-2216)	OTHER	Sample Remarks
SB1-A	1/14/99	1040	32.5	33	soil	1	X	X	X	99-A6176	X		perform matrix spike
SB2-A	1/14/99	1325	15	15.5	soil	1	X	X	X	99-A6177	X		
SB9-A	1/14/99	1200	15.5	16	soil	1	X	X	X	99-A6178	X		
SB7-A	1/15/99	1000	18	18.5	soil	1	X	X	X	99-A6179	X		
SB7-B	1/15/99	1042	24	24.5	soil	1	X	X	X	99-A6180	X		
					soil								
					soil								
					soil								
					soil								
					soil								
					soil								
					soil								

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
Andrea Bielskis	1/15/99				
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED FOR LAB BY: (SIGNATURE)	DATE	TIME
			M. Bradley 4°c	1/16/99	9:00

SPECIFIC ANALYTICAL METHOD FOOTNOTES:
1. Deionized water extraction (California Title 22 method); DO LEACHABLE ONLY IF TOTAL TPH IS DETECTED AND AFTER CONSULTATION WITH SITE MANAGER (PHELPS).

GENERAL COMMENTS/INSTRUCTIONS:
1. FAX chain-of-custody on check-in to site manager (Phelps).
2. QC and reporting limits of contract 726876.3016.00 must be met.
3. Option 2 pricing applies and IRPIMS electronic deliverable IS required.

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples

Cooler Receipt Form

Client: Parsons Engineering Science

Cooler Received On: 1/15/99 And Opened On: 1/15/99 By: Mark Beasley

Mark Beasley
(Signature)

1. Temperature of Cooler when opened 4c

2. Were custody seals on outside of cooler and intact? (Yes) No

   a. If yes, what kind and where: Tape 2 Front/Back

   b. Were the signature and date correct? (Yes) No

3. Were custody papers inside cooler? (Yes) No

4. Were custody papers properly filled out (ink, signed, etc)? (Yes) No

5. Did you sign the custody papers in the appropriate place? (Yes) No

6. What kind of packing material was used? Bubblewrap

7. Was sufficient ice used (if appropriate)? (Yes) No

8. Did all bottles arrive in good condition (unbroken)? (Yes) No

9. Were all bottle labels complete (#, date, signed, pres, etc)? (Yes) No

10. Did all bottle labels and tags agree with custody papers? (Yes) No

11. Were correct bottles used for the analysis requested? (Yes) No

12. If present, were VOA vials checked for absence of air bubbles and noted if found? (Yes) No

13. Was sufficient amount of sample sent in each bottle? (Yes) No

14. Were correct preservatives used? (Yes) No

15. Corrective action taken, if necessary:

   a. Name of person contacted: _____

   b. Date _____

000003

FedEx USA Airbill

FedEx Tracking Number 802892678284

Form I.D. No. 0200

SPL13

1 From

Date 1/15/99

Sender's Name Amanda Bielskis Phone (510) 891-9085

Company PARSONS ENG SCIENCES INC

Address 2101 WEBSTER ST 7TH FL Dept./Floor/Suite/Room

City OAKLAND State CA ZIP 94612

2 Your Internal Billing Reference Information 726876.36120

3 To

Recipient's Name Bruce Schlatter Phone ( )

Company Specialized Assays, Inc

Address 2960 Foster Creighton Dr ☐ Check here if residence (Extra charge applies for FedEx Express Saver)
(To "HOLD" at FedEx location, print FedEx address here) Dept./Floor/Suite/Room

City Nashville State TN ZIP 37204

For HOLD at FedEx Location check here

☐ Hold Weekday (Not available with FedEx First Overnight)
☐ Hold Saturday (Not available at all locations) (Available for FedEx Priority Overnight and FedEx 2Day only)

For Saturday Delivery check here

☒ (Extra Charge. Not available to all locations) (Available for FedEx Priority Overnight and FedEx 2Day only)

802892678284

4a Express Package Service *Packages under 150 lbs.* Delivery commitment may be later in some areas.

☐ FedEx Priority Overnight (Next business morning)
☒ FedEx Standard Overnight (Next business afternoon)
☐ FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)
☐ FedEx 2Day (Second business day)
☐ FedEx Express Saver (Third business day)
FedEx Letter Rate not available. Minimum charge: One pound rate.

4b Express Freight Service *Packages over 150 lbs.* Delivery commitment may be later in some areas.

☐ FedEx Overnight Freight (Next business day)
☐ FedEx 2Day Freight (Second business day)
☐ FedEx Express Saver Freight (Up to 3 business days)

(Call for delivery schedule. See back for detailed descriptions of freight services.)

5 Packaging ☐ FedEx Letter ☐ FedEx Pak ☐ FedEx Box ☐ FedEx Tube ☒ Other Pkg.
Declared value limit $500

6 Special Handling (One box must be checked)

Does this shipment contain dangerous goods?* ☒ No ☐ Yes (As per attached Shipper's Declaration) ☐ Yes (Shipper's Declaration not required)

☐ Dry Ice Dry Ice, 9, UN 1845 ____ x ____ kg

CA ☐ Cargo Aircraft Only

*Dangerous Goods cannot be shipped in FedEx packaging

7 Payment Obtain Recipient FedEx Account No.

Bill to: ☐ Sender (Account no. in section 1 will be billed) ☒ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check
(Enter FedEx account no. or Credit Card no. below)

Total Packages	Total Weight	Total Declared Value*	Total Charges
1	14	$ 2500.00	$

* When declaring a value higher than $100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE, AND LIMIT OF LIABILITY section for further information

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

288

Questions?
Call 1-800-Go-FedEx (800)463-3339

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004067725 7

VOLATILE ORGANICS 8021B

SUMMARY DATA

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-1A

32.5-33 f

Matrix: Soil
% Dry Weight: 84.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 127679
Instrument: HP-19

Lab Sample ID: 99-A6176
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/21/99
Analysis Time: 20:54
Sample QC Group: 1247

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000005

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-2A

15.5-16 ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 127679
Instrument: HP-19

Lab Sample ID: 99-A6177
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/21/99
Analysis Time: 21:31
Sample QC Group: 1247

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	4.9	
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	15.9	

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-9A SB2 15.5-16 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 127679
Instrument: HP-19

Lab Sample ID: 99-A6178
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/21/99
Analysis Time: 22:09
Sample QC Group: 1247

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	4.8	

000007

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-7A 18-18.5 ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 127679
Instrument: HP-19

Lab Sample ID: 99-A6179
Date Sampled: 1/15/99
Date Received: 1/18/99
Analysis Date: 1/21/99
Analysis Time: 22:47
Sample QC Group: 1247

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	U
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000008

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-7B

24 - 24.5 ft

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8021B
Delivery Group: 127679
Instrument: HP-19

Lab Sample ID: 99-A6180
Date Sampled: 1/15/99
Date Received: 1/18/99
Analysis Date: 1/21/99
Analysis Time: 23:24
Sample QC Group: 1247

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.2	
108-88-3	Toluene	2.4	U
100-41-4	Ethylbenzene	2.4	U
1330-20-7	Xylenes, total	2.4	U

000009

COPY 1

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

BLANK

Matrix: Soil
% Dry Weight: 100
Units: UG/KG
Dilution Factor: 1
Analysis Method: SW8015
Delivery Group: 127679
Instrument: HP-19

Lab Sample ID: BLANK
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/21/99
Analysis Time: 20:16
Sample QC Group: 1247

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
71-43-2	Benzene	1.	U
108-88-3	Toluene	2.	U
100-41-4	Ethylbenzene	2.	U
1330-20-7	Xylenes, total	2.	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

SB7-B MS

Lab Name: SPECIALIZED ASSAYS Contract: _____

Lab Code SASSAYS Site: _____ Location: _____ SDG 127679

Matrix: (soil/water) SOIL Lab Sample ID: 6180 MS

Sample wt/vol: 5.0 (g/mL) g Lab File ID: 0121HP19.009

Level: (low/med) N/A Date Received: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/22/99

GC Column: DB-VRX ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Concentration Units: (ug/L or ug/Kg) ug/Kg

CAS No.	Compound		Q
	BENZENE	51.6	
	TOLUENE	47.9	
	ETHYLBENZENE	50.0	
	m,p-XYLENE	92.3	
	o-XYLENE	49.4	

FORM I VOA 3/90

000052

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

SB7-B MSD

Lab Name: SPECIALIZED ASSAYS Contract: _____

Lab Code SASSAYS Site: _____ Location: _____ SDG 127679

Matrix: (soil/water) SOIL Lab Sample ID: 6180 MSD

Sample wt/vol: 5.0 (g/mL) g Lab File ID: 0121HP19.010

Level: (low/med) N/A Date Received: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/22/99

GC Column: DB-VRX ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Concentration Units: (ug/L or ug/Kg) ug/Kg

CAS No.	Compound		Q
	BENZENE	49.4	
	TOLUENE	46.5	
	ETHYLBENZENE	48.3	
	m,p-XYLENE	89.0	
	o-XYLENE	47.4	

FORM I VOA 3/90

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CONTROL S 01

Lab Name: SPECIALIZED ASSAYS Contract:

Lab Code SASSAYS Site: Location: SDG 127679

Matrix: (soil/water) SOIL Lab Sample ID: CONTROL S 01

Sample wt/vol: 5.0 (g/mL) g Lab File ID: 0121HP19.011

Level: (low/med) N/A Date Received: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/22/99

GC Column: DB-VRX ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/Kg	Q
	BENZENE	50.9	
	TOLUENE	48.1	
	ETHYLBENZENE	50.2	
	m,p-XYLENE	92.9	
	o-XYLENE	49.5	

FORM I VOA 3/90

TPH 8015B – DIESEL RANGE

SUMMARY DATA

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-1A

Matrix: Soil
% Dry Weight: 84.
Units: ug/kg dry weight
Dilution Factor: 10.
Analysis Method: SW8015
Delivery Group: 127679
Instrument:
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A6176
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/20/99
Analysis Time: 12:20
Sample QC Group: 4811

Extraction Date: 1/19/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	264000	....

000060

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-2A

15-15.5 ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 127679
Instrument:
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A6177
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/19/99
Analysis Time: 20:22
Sample QC Group: 4811

Extraction Date: 1/19/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	39900	....

000061

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-9A SB2 15.5-16 f

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 127679
Instrument:
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A6178
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/19/99
Analysis Time: 20:51
Sample QC Group: 4811

Extraction Date: 1/19/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	64600	....

000062

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-7A 18-18.5 ft

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 127679
Instrument:
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A6179
Date Sampled: 1/15/99
Date Received: 1/18/99
Analysis Date: 1/19/99
Analysis Time: 21:20
Sample QC Group: 4811

Extraction Date: 1/19/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	2490	J

000063

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB-7B

24 - 24.5'

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 127679
Instrument:
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A6180
Date Sampled: 1/15/99
Date Received: 1/18/99
Analysis Date: 1/19/99
Analysis Time: 21:44
Sample QC Group: 4811

Extraction Date: 1/19/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	6410	J

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

BLANK

Matrix: Soil
% Dry Weight: 100
Units: UG/KG
Dilution Factor: 1
Analysis Method: SW8270B
Delivery Group: 127679
Instrument:
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: BLANK
Date Sampled: 1/14/99
Date Received: 1/18/99
Analysis Date: 1/20/99
Analysis Time: 12:20
Sample QC Group: 4811

Extraction Date: 1/19/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	10000	U

000064

1A

PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

SAMPLE NO.

SB1-A MS

Lab Name: SPECIALIZED ASSAYS Contract:

SDG # 127679 Site: Location: Group:

Matrix: (soil/water): SOIL Lab Sample ID: 43729 SSG

Sample (wt/vol): 25 (g/mL) g Lab File ID: 0119PE1.004

Level: (low/med) LOW Date Recieved: 1/18/99

%Moisture: non dec. 16 Date Analyzed: 1/19/99

GC Column: ZB-1 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: 1000 (uL) Soil Aliquot Volume: 1 (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg)	ug/Kg	Q
	DIESEL FUEL		284000	E

000095

1A

PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

SAMPLE NO.

SB1-A MSD

Lab Name: SPECIALIZED ASSAYS Contract:

SDG # 127679 Site: Location: Group:

Matrix: (soil/water): SOIL Lab Sample ID: 43730 SSG

Sample (wt/vol): 25 (g/mL) g Lab File ID: 0119PE1.005

Level: (low/med) LOW Date Recieved: 1/18/99

%Moisture: non dec. 16 Date Analyzed: 1/19/99

GC Column: ZB-1 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: 1000 (uL) Soil Aliquot Volume: 1 (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg)	ug/Kg	Q
	DIESEL FUEL		176000	E

000097

1A

PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

SAMPLE NO.

CONTROL S

Lab Name: SPECIALIZED ASSAYS Contract:

SDG # 127679 Site: Location: Group:

Matrix: (soil/water): SOIL Lab Sample ID: 45882 LCS

Sample (wt/vol): 25 (g/mL) g Lab File ID: 0119PE1.006

Level: (low/med) LOW Date Recieved: 1/18/99

%Moisture: non dec. 0 Date Analyzed: 1/19/99

GC Column: ZB-1 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: 1000 (uL) Soil Aliquot Volume: 1 (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg)	ug/Kg	Q
	DIESEL FUEL		66200	

000099

SPECIALIZED ASSAYS INC. • 2960 Foster Creighton Dr. • P.O. Box 40566 • Nashville, Tennessee 37204-0566
615-726-0177 • 1-800-765-0980 • Fax 615-726-3404

Rec'd 2/15/99
from JWR

CASE NARRATIVE

Client: Parsons Engineering Science (8185)
Attn: John Ratz
1700 Broadway, Suite 900
Denver, CO 80290

Client Project: McCLELLAN AFB, Site Davis — Matrix: Soil

Laboratory Project: 128993 — Number samples: 3

Date Received: 01/15/99 — Date Collected: 1/14/99

Sample Receipt Notes: All samples were received in good condition, properly preserved. There were no discrepancies noted on the cooler receipt form. Based upon the results of the original analyses, request for TPH-DRO by method SW8015B using a DI-WET extract was requested.

QA/QC Summary:

Extractable TPH – 8015B– Batch 3253

All surrogate and QC parameters are within acceptable limits. Due to sample volume limitations, de-ionized water was used to prepare the matrix spike/spike duplicate samples. There are no QC anomalies noted in the data package.

The enclosed disk contains the IRPIMS deliverables for this sample delivery group. If you have any technical issues relating to the enclosed data, please call me at 1-800-765-0980.

Johnny A. Mitchell
Director of Technical Services

PARSONS ENGINEERING SCIENCE, INC.
2101 Webster Street, Suite [illegible]
Oakland, California 94612
Phone: (510) 891-9085
FAX: (510) 835-4355

CHAIN OF CUSTODY RECORD

Project No.: 726876.36120 Lab Account No.: 8185

Project Name/Location: McClellan AFB; Davis Site

Site Manager: Michael Phelps (Oakland, CA)

Project Manager: John Ratz (Denver, CO)

Samplers: (Initials and Signatures)
AFB
Anita Bucklis

Lab: Bruce Schlatter/Mary Louise Linn
Specialized Assays, Inc. (SAI)
2960 Foster Creighton Drive
Nashville, TN 37204
(615) 726-0177
Fax:(615) 726-3404

Sample ID	Date	Time	Begin Depth	End Depth	Matrix	NO. OF CONTAINERS	ORGANICS: Extract. TPHDRO (8015M)	ORGANICS: Leachable TPHDRO (DI-WET/8015M) note 1	ORGANICS: BTEX (8020A)	ORGANICS: V Organic Carbon (SW8260)	INORGANICS: Moisture Content (ASTM D-2216)	OTHER	Sample Remarks
SB1-A	1/14/99	1040	32.5	33	soil	1	X	X	X	99-A11230	X		perform matrix spike
SB2-A	1/14/99	1325	15	15.5	soil	1	X	X	X	99-A11231	X		
SB9-A	1/14/99	1200	15.5	16	soil	1	X	X	X	99-A11232	X		
SB7-A	1/15/99	1000	18	18.5	soil	1	X	X	X	99-A11179	X		
SB7-B	1/15/99	1042	24	24.5	soil	1	X	X	X	99-A11180			
					soil								
					soil								
					soil								
					soil								
					soil								
					soil								
					soil								

See attached

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
Anita Bucklis	1/17/99				
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED FOR LAB BY: (SIGNATURE)	DATE	TIME

SPECIFIC ANALYTICAL METHOD FOOTNOTES:
1. Deionized water extraction (California Title 22 method); DO LEACHABLE ONLY IF TOTAL TPH IS DETECTED AND AFTER CONSULTATION WITH SITE MANAGER (PHELPS).

GENERAL COMMENTS/INSTRUCTIONS:
1. FAX chain-of-custody on check-in to site manager (Phelps).
2. QC and reporting limits of contract 726876.3016.00 must be met.
3. Option 2 pricing applies and EDPIMS electronic deliverable IS required.

Distribution: Original accompanies shipment, photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

0000 1

JAN 28 '99 09:29HT PARSONS ES

PARSONS ENGINEERING SCIENCE, INC.
2101 Webster Street, Suite 700 • Oakland, California 94612 • (510) 891-9085 • Fax: (510) 835-4355

FAX MESSAGE

Date: January 25, 1999 **Proposal/Project No.:** 726876.36120

TO
Name: Attn: Kathy Client Services URGENT!
Organiz.: SAI
Fax No.: (615) 726-~~0954~~ 3404
Phone Number: (615) 726-0177

FROM
Name: Michael Phelps MP
E-mail: michael_phelps@parsons.com
Fax Number: (510) 835-4355
Phone Number: (510) 891-9085

Subject: DI-WET Analysis for McClellan (Lab no. 8185)

Response Requested: YES
Date Required: 1/29/99

MESSAGE/INSTRUCTIONS

Client Services,

At Mary Louise Linn's request I am sending you a list of soil samples requiring DI-WET/8015 analysis (leachable TPH) by the California Title 22 Method. NOTE: Hold times for these samples will expire starting today! Do not miss these hold times. I am enclosing the original COC, but only the samples listed below are to be analyzed by DI-WET/8015.

In addition, I have enclosed a COC for samples with hold times expiring starting on Monday, 2/1. I need to receive preliminary results for TPH from these samples by tomorrow, Friday, 1/29 so that I can make a decision on which of them also need DI-WET analysis.

Please return a confirmation.

Sample ID	Your Lab ID	Date of Collection
SB-1A	99-A6176	1/14/99
SB-2A	99-A6177	1/14/99
SB-9A	99-A6178	1/14/~~98~~ 99

Number of Pages Transmitted: 4
(including this sheet)

TPH/DIESEL - WATER

Summary Data

Specialized Assays, Inc.
2960 Foster Creighton Drive
Nashville, TN 37204
(800) 765-0980

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB1-A

32.5-33 f.

Matrix: Water
pH:
Units: ug/l
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128993
Instrument: PE-5
Vol Extracted: 930. ml
Extract Vol: 1.00 ml

Lab Sample ID: 99-A11230
Date Sampled:: 1/14/99
Date Received: 1/16/99
Analysis Date: 2/ 4/99
Analysis Time: 0:50
Sample QC Group: 3253

Extraction Date: 2/ 2/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	550	....

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB2-A 15-15.5 ft

Matrix: Soil
% Dry Weight:
Units:
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128993
Instrument: PE-5
Vol Extracted: 750. ml
Extract Vol: 1.00 ml

Lab Sample ID: 99-A11231
Date Sampled: 1/14/99
Date Received: 1/16/99
Analysis Date: 2/ 4/99
Analysis Time: 1:21
Sample QC Group: 3253

Extraction Date: 2/ 2/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	130	.... U

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

SB9-A

15.5 - 16 ft

Matrix: Soil
% Dry Weight:
Units:
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128993
Instrument: PE-5
Vol Extracted: 990. ml
Extract Vol: 1.00 ml

Lab Sample ID: 99-A11232
Date Sampled: 1/14/99
Date Received: 1/16/99
Analysis Date: 2/ 4/99
Analysis Time: 1:51
Sample QC Group: 3253

Extraction Date: 2/ 2/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	130	....

SPECIALIZED ASSAYS, INC.
2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

BLANK

Matrix: Water
% Dry Weight:
Units: UG/L
Dilution Factor: 1
Analysis Method: SW8015
Delivery Group: 128993
Instrument: PE-5
Vol Extracted: 1000 ml
Extract Vol: 1.0 ml

Lab Sample ID: BLANK
Date Sampled: 1/14/99
Date Received: 1/16/99
Analysis Date: 2/ 3/99
Analysis Time: 22:49
Sample QC Group: 3253

Extraction Date: 2/ 2/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	100.	U

1A

PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

SAMPLE NO.

TBLK01 MS

Lab Name: SPECIALIZED ASSAYS Contract: _____

SDG # 128993 Site: _____ Location: _____ Group: _____

Matrix: (soil/water): WATER Lab Sample ID: 42360 WSG

Sample (wt/vol): 1000 (g/mL) mL Lab File ID: 0202PE5.056

Level: (low/med) LOW Date Recieved: 1/16/99

%Moisture: non dec. 0 Date Analyzed: 2/3/99

GC Column ZB-1 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: 1000 (uL) Soil Aliquot Volume: 1 (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
	DIESEL FUEL	1540	

000032

1A

PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

SAMPLE NO.

TBLK01 MSD

Lab Name: SPECIALIZED ASSAYS Contract: _____

SDG # 128993 Site: _____ Location: _____ Group: _____

Matrix: (soil/water): WATER Lab Sample ID: 42361 WSG

Sample (wt/vol): 1000 (g/mL) mL Lab File ID: 0202PE5.057

Level: (low/med) LOW Date Recieved: 1/16/99

%Moisture: non dec. 0 Date Analyzed: 2/3/99

GC Column ZB-1 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: 1000 (uL) Soil Aliquot Volume: 1 (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
	DIESEL FUEL	1830	

000034

1A

PETROLEUM HYDROCARBON ANALYSIS DATA SHEET

SAMPLE NO.

CONTROL W

Lab Name: SPECIALIZED ASSAYS Contract: _____

SDG # 128993 Site: _____ Location: _____ Group: _____

Matrix: (soil/water): WATER Lab Sample ID: 46233 LCS

Sample (wt/vol): 1000 (g/mL) mL Lab File ID: 0202PE5.058

Level: (low/med) LOW Date Recieved: 1/16/99

%Moisture: non dec. 0 Date Analyzed: 2/4/99

GC Column ZB-1 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: 1000 (uL) Soil Aliquot Volume: 1 (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
	DIESEL FUEL	1610	

00003(

APPENDIX D

DATA QUALITY ASSESSMENT REPORT

DATA QUALITY ASSESSMENT REPORT
DAVIS GLOBAL COMMUNICATIONS SITE
MCCLELLAN AIR FORCE BASE, CALIFORNIA

D1.0 INTRODUCTION

A Parsons Engineering Science electronic Level III validation was performed for the Davis Global Communications Site operated by McClellan Air Force Base (AFB), California and consisted of electronically and manually examining data deliverables to determine data quality. This included application of data qualifiers to the analytical results based on adherence to method protocols and project-specific quality assurance/quality control (QA/QC) limits. Method protocols reviewed included:

- analytical holding times,
- method blanks (MB),
- trip blanks (TB),
- surrogate spikes,
- matrix spikes/matrix spike duplicates (MS/MSDs),
- laboratory control samples (LCSs), and
- shipping cooler temperature.

Data qualifiers were applied to analytical results during the data validation process. All data were validated using method applicable guidelines and in accordance with the *National Functional Guidelines for Organic Data Review* (USEPA, 1994a) and the *National Functional Guidelines for Inorganic Data Review* (USEPA, 1994b).

The following definitions provide explanations of the USEPA (1994a and 1994b) qualifiers assigned to analytical results during data validation. The data qualifiers described were applied to both inorganic and organic results.

U - The analyte was analyzed for and is not present above the reported sample quantitation limit (SQL).

J - The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environmental sample. The data should be considered as a basis for decision-making and are usable for many purposes.

R - The data are rejected as unusable for all purposes. The analyte was analyzed for, but the presence or absence of the analyte was not verified. Resampling and reanalysis are necessary to confirm the presence or absence of the analyte.

UJ - The analyte analyzed for was not present above the reported SQL. The associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample.

J1 The analyte is qualified as an estimated value solely because it is greater than the method detection limit (MDL) and less than the PQL indicating no laboratory quality issues.

D2.0 DATA QUALITY

Data quality for each QC parameter where exceptions were noted during the validation is summarized in this section. Only results that exceeded QA/QC criteria are presented. All frequency requirements for field sample collection of QA/QC samples (MS/MSDs and blanks) were met. The frequency requirements for laboratory specific method criteria QA/QC were met overall. In Attachment A, Tables A-1 and A-2 present the analytical methods performed for each samples and the samples that were qualified during the validation process, respectively.

D2.1 Surrogates

Table D2.1-1 lists all results for target analytes that are out of control with the percentage of out of control results calculated against the total number of samples collected. For method SW8021, the surrogate recovery for one sample was high, resulting in qualifications of the detected compounds (benzene) in that sample. The results were qualified as estimated.

TABLE D2.1-1
OUT-OF-CONTROL SURROGATES IMPACT
DAVIS GLOBAL COMMUNICATIONS SITE
MCCLELLAN AFB, CALIFORNIA

Anal. Method	Prep. Method	Matrix	Analyte	Flag	# of Qualified Results	Total Number of Samples	Percent of Results Qualified
SW8021	SW5030	SO	Benzene	J	1	18	6%

D2.2 Field Duplicates

Table D2.2-1 lists the field duplicate results for compounds where at least one sample in the duplicate pair was detected. The relative percent difference (RPD) or range was out of control for several compounds (bolded values). Although the soil

samples are not true duplicates, the high variability between the replicates indicates sampling precision is poor. This is probably due to the non-homogeneous nature of the soil within a borehole. The data is not qualified based on field duplicate results.

TABLE D2.2-1
FIELD DUPLICATES
DAVIS GLOBAL COMMUNICATIONS SITE
MCCLELLAN AFB, CALIFORNIA

Location	Matrix	SBD	SED	Anal. Method	Prep. Method	Sample Dup Result	Sample Result	LABDL	RPD	Range	Units	Analyte
SB2	SO	15.5	16	SW8015	SW3550	64600	39900	12000	**47%**		UG/KG	TPH (Diesel Range)
SB2	SO	15.5	16	SW8021	SW5030	4.8	15.9	2.4	**107%**		UG/KG	Xylenes, total
SB11	SO	11.5	12.5	SW8015	SW3550	1690	1980	12000	16%	290	UG/KG	TPH (Diesel Range)
SB2	SO	15	15.5	SW8015	SW1311	130	130	100	0%	0	UG/L	TPH (Diesel Range)
SB2	SO	15.5	16	SW8021	SW5030	0	4.9	2.4	**200%**	4.9	UG/KG	Toluene

D3.0 CONCLUSIONS

Samples were collected and analyzed as specified in the methods with exception of those issues discussed in this report. All samples are representative of the site and comparable with previous and future investigations (when used in accordance with the validation qualifiers). All sample results qualified as "UJ or J" represent an association to non-compliant QC criteria that has caused the reported concentration to be estimated. Project objectives do not exclude the use of estimated concentrations. No data was rejected based on the validation, therefore completeness goals of 90 percent were met. Therefore, all data are usable for the purposes intended.

4.0 REFERENCES

U.S. Environmental Protection Agency (USEPA). 1983. Methods for the Chemical Analysis of Water and Wastes. EPA 600/4-79-020. Cincinnati, OH.

USEPA. 1993. Data Quality Objectives Process for Superfund. EPA 540-R-93-071. Washington, DC. September, 1993.

USEPA. 1987-1996. SW-846, Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, Third Edition. Washington, DC.

USEPA. 1994a. Agency National Functional Guidelines for Organic Data Review. PB 94-963502. Washington, DC.

USEPA. 1994b. Agency National Functional Guidelines for Inorganic Data Review. PB 94-963501. Washington, DC.

ATTACHMENT A

VALIDATED SAMPLES AND QUALIFIED ANALYTICAL RESULTS

VALIDATED SAMPLES AND QUALIFIED ANALYTICAL RESULTS

Tables A-1 and A-2 list all qualified sample data based on the results of data validation. The following definitions of column headers will aide in the understanding and use of these tables.

LOCID: Sample location identifier, unique to each sample when used in conjunction of columns SBD and SED.

MX: Sample matrix identifier. "SO" is soil, "WG" is water.

SA: Sample analysis identifier. "N" is for primary field samples, "FR" is for field replicate samples. "N1" or "FR1" designates that the results associated to the original sample analysis. "N8" or "FR8" designates that the results associated to a composite of sample analysis results.

SBD: Sample beginning depth.

SED: Sample ending depth.

COMPOUND NAME: This column identifies the target compound name.

VQ: This column designates if a target compound was detected or not. An "=" denotes a detection above the project practical quantitation limit. A "ND" denotes a non-detection above the method detection limit. A "TR" denotes a detection above the method detection limit but below the project practical quantitation limit.

PARVAL: This is the concentration of detection for all detected sample results (TR or =). A zero is a placeholder, which associates to a non-detected compound. The zero does not imply that the compound was not detected at less than zero.

LABDL: This is the concentration at which the laboratory reports the project reporting limit. The project reporting limit is a practical quantitation limit in that it is related to a multiplier of the method detection limit.

ANMCODE: Analytical method code identifier.

EXMCODE: Analytical extraction method code identifier.

Q: This column represents the final validation qualifier applied to the sample result. It is a composite of all the validation qualifiers for that sample result.

The following column headers apply to the method criteria that are included in a data validation. All of the columns may not appear in Table A-2. Only those method criteria that resulted in qualifying sample results are listed.

HTM	Holding Time
MBM	Method Blank
TBM	Trip Blanks
EBM	Equipment Blanks
ABM	Ambient Blanks
MSRM	MS/MSD (%Recovery/Accuracy)
MSPM	MS/MSD (%RPD/Precision)
LCRM	LCS (%Recovery/Accuracy)
LCPM	LCS (%RPD/Precision)
SURM	Surrogate
TMPM	Temperature
PRSM	Preservation

TABLE A-1
ANALYTICAL METHODS BY SAMPLE LOCATION
DAVIS GLOBAL COMMUNICATIONS SITE
MCCLELLAN AFB, CALIFORNIA

LOCID	SBD	SED	MATRIX	SW8015 - SW1311	SW8015 - SW3550	SW8021 - SW5030
				(Cal WET- DRO)	(TPH-DRO)	(BTEX)
SB1	32.5	33	SO	X	X	X
SB11	11.5	12.5	SO		X	X
SB11	21	21.5	SO		X	X
SB2	15	15.5	SO	X	X	X
SB2	15.5	16	SO	X	X	X
SB3	9	9.5	SO	X	X	X
SB3	22.5	23	SO		X	X
SB4	13.5	14	SO		X	X
SB4	21	21.5	SO		X	X
SB5	13.5	14	SO		X	X
SB5	21	21.5	SO		X	X
SB6	12.5	13	SO		X	X
SB6	23	23.5	SO		X	X
SB7	18	18.5	SO		X	X
SB7	24	24.5	SO		X	X
SB8	13	13.5	SO		X	X
SB8	24	24.5	SO		X	X

TABLE A-2
QUALIFIED ANALYTICAL RESULTS
DAVIS GLOBAL COMMUNICATIONS SITE
MCCLELLAN AFB, CALIFORNIA

LOCID	SBD	SED	MATRIX	SA CODE	ANM CODE	EXM CODE	ANALYTE	PARVQ	PARVAL	LABDL	UNITS	FINAL Q	SURM
SB8	13	13.5	SO	N1	SW8021	SW5030	Benzene	=	1.7	1.2	UG/KG	J	J